TORO

Service Manual

Groundsmaster 7200/7210

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Groundsmaster 7200 and 7210.

REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manual and Parts Catalog for your machine. Replacement Operator's Manuals and Parts Catalogs are available on the internet at www.Toro.com or by sending complete Model and Serial Number to:

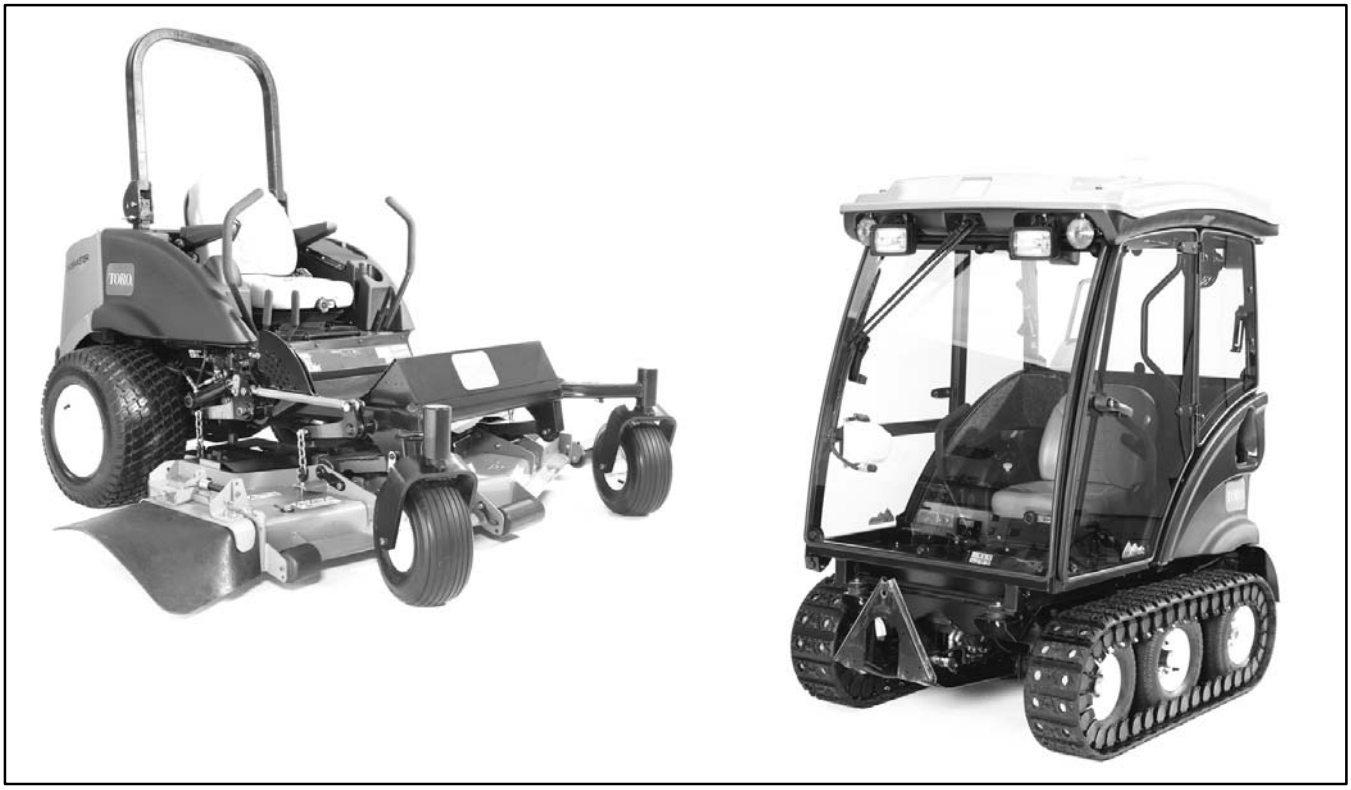
The Toro Company
Attn. Technical Publications
8111 Lyndale Avenue South
Bloomington, MN 55420–1196

The Toro Company reserves the right to change product specifications or this publication without notice.

This safety symbol means DANGER, WARNING or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.

NOTE: A **NOTE** will give general information about the correct operation, maintenance, service, testing or repair of the machine.

IMPORTANT: The IMPORTANT notice will give important instructions which must be followed to prevent damage to systems or components on the machine.



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Chapter 1

Safety

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General Safety Instructions

Groundsmaster 7200 and 7210 machines meet or exceed safety standard specifications as identified in the Operator's Manual. Although hazard control and accident prevention are dependent partially upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance by the operator or owner of the machine can result in injury. To reduce the potential for any injury, comply with the following safety instructions as well as information found in the Operator's Manual.

WARNING

To reduce the potential for injury or death, comply with the following safety instructions.

Supervisor's Responsibilities

1. Make sure operators are thoroughly trained and familiar with the Operator's Manual, Operator Training DVD and all of the operating and safety decals on the machine.

2. Be sure to establish your own special procedures and work rules for unusual operating conditions (e.g. slopes too steep for machine operation). **Survey mowing site completely to determine which hills can be operated on safely.** When performing this site survey, always use common sense and take into consideration the turf condition and the rollover risk. To perform a site survey, follow the procedure outlined in the Operator's Manual.

Before Operating

1. Review and understand the contents of the Operator's Manual and Operator Training DVD before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. A replacement Operator's Manual is available on the Internet at www.Toro.com or by sending the complete model and serial number to:

   The Toro Company
   Attn. Technical Publications
   8111 Lyndale Avenue South
   Bloomington, Minnesota 55420–1196

2. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective, illegible or damaged, repair or replace it before operating the machine.

3. Tighten any loose nuts, bolts or screws to ensure machine is in safe operating condition.

4. Assure interlock switches are adjusted correctly so engine cannot be started unless both drive handles are in the neutral lock position, the PTO switch is OFF (disengaged) and either the seat is occupied or the parking brake is applied.

5. Since fuel is highly flammable, handle it carefully:

   A. Store fuel in containers specifically designed for this purpose.

   B. Do not remove machine fuel tank cap while engine is hot or running.

   C. Do not smoke while handling fuel.

   D. Fill fuel tank outdoors and only to within an inch of the top of the tank, not the filler neck. Do not overfill.

   E. Replace fuel tank and fuel container caps securely after refueling machine.

   F. If fuel is spilled, do not attempt to start the engine but move the machine away from the area of the spillage. Avoid creating any source of ignition until fuel vapors have dissipated. Wipe up any spilled fuel.

While Operating

1. Sit on the seat when starting and operating the machine.

2. Before starting the engine:

   A. Engage the parking brake.

   B. Make sure both drive handles are in the neutral lock position and the PTO switch is OFF (disengaged).

   C. After engine is started, release parking brake and keep both drive handles in the neutral lock position. Machine must not move. If movement is evident, the traction linkage is adjusted incorrectly; therefore, shut engine off and adjust traction linkage until machine does not move when both drive handles are in the neutral lock position.

3. Do not run engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could possibly be deadly.

4. Do not touch engine, radiator or exhaust system while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.

5. Before getting off the seat:

   A. Ensure that both drive handles are in the neutral lock position.

   B. Lower and disengage cutting deck (or implement) and wait for all movement to stop.

   C. Set parking brake.

   D. Stop engine and remove key from ignition switch.

6. Anytime the machine is parked (short or long term), the cutting deck (or implement) should be lowered to the ground. This relieves pressure from the lift circuit and eliminates the risk of the cutting deck (or implement) accidentally lowering to the ground.

7. Do not park on slopes unless wheels are chocked or blocked.

Maintenance and Service

1. Before servicing or making adjustments, lower cutting deck (or implement), stop engine, set parking brake and remove key from the switch.

2. Make sure machine is in safe operating condition by keeping all nuts, bolts and screws tight.

3. Never store the machine or fuel container inside where there is an open flame, such as near a water heater or furnace.

4. Make sure all hydraulic line connectors are tight, and all hydraulic hoses and lines are in good condition before applying pressure to the hydraulic system.

5. Keep body and hands away from pin hole leaks in hydraulic lines that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks. Hydraulic fluid escaping under pressure can penetrate skin and cause injury. Fluid accidentally injected into the skin must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.

6. Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved by parking the machine on a level surface, lowering the cutting deck (or implement) completely to the ground and then stopping the engine.

7. When working on the hydraulic system and its components, wear eye protection.

8. If major repairs are ever needed or assistance is desired, contact your Authorized Toro Distributor.

9. Use care when checking or servicing the cutting deck. Wear gloves and use caution when servicing it.

10. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt. Clean protective screen on machine frequently.

11. If engine must be running to perform maintenance or to make an adjustment, keep hands, feet, clothing and other parts of the body away from the cutting deck (or implement) and other moving parts. Keep bystanders away.

12. Do not overspeed the engine by changing engine governor setting. To assure safety and accuracy, check maximum engine speed with a tachometer.

13. Shut engine off before checking or adding oil to the engine crankcase.

14. Disconnect battery before servicing the machine. Disconnect negative battery cable first and positive cable last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery. Reconnect positive battery cable first and negative cable last.

15. Battery acid is poisonous and can cause burns. Prevent acid contact with skin, eyes and clothing. Protect your face, eyes and clothing when working with a battery.

16. Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

17. If welding on the machine is necessary, disconnect the battery cables to prevent electrical system damage. Disconnect negative battery cable first and positive cable last.

18. At the time of manufacture, the machine conformed to the safety standards for riding mowers. To assure optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in non-conformance with the safety standards, and the warranty may be voided.

19. When changing attachments, tires or performing other service, use correct blocks, hoists and jacks. Make sure machine is parked on a solid level floor such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use appropriate jack stands to support the raised machine. If the machine is not properly supported by appropriate jack stands, the machine may move or fall, which may result in personal injury (see Jacking Instructions in this section).

Jacking Instructions

CAUTION

When changing attachments, tires or performing other service, use correct blocks, hoists and jacks. Make sure machine is parked on a solid level floor such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use appropriate jack stands to support the raised machine. If the machine is not properly supported by appropriate jack stands, the machine may move or fall, which may result in personal injury.

Jacking the Front

1. Apply parking brake and chock both rear tires to prevent the machine from moving.

2. Position jack to machine:

   A. On machines with cutting deck, position jack securely under the square carrier frame tube near the front castor wheel (Fig. 1). Do not use the cutting deck as a jacking point.

   B. On machines with Polar Trac™ Kit, position jack securely under the lift arm pivot tube on the front of machine. Do not use the implement as a jacking point.

3. Use jack to raise front of machine.

4. After raising the front of the machine, use appropriate jack stands under the frame to support the front of the machine.

Jacking the Rear (Fig. 2)

IMPORTANT: Do not support machine on wheel hubs (brake rotors).

1. Chock both front castor wheels to prevent the machine from moving.

2. Place jack securely under the rear frame.

3. Jack rear wheels off the ground.

4. Use appropriate jack stands under the frame to support the rear of the machine.

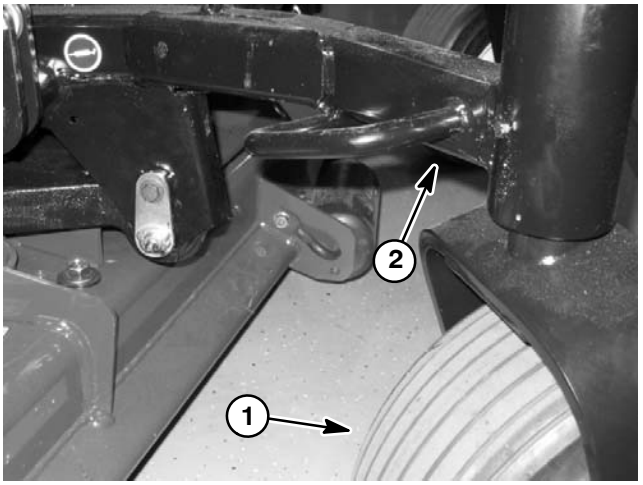

Figure 1

1. Front castor wheel **2. Front jacking point**

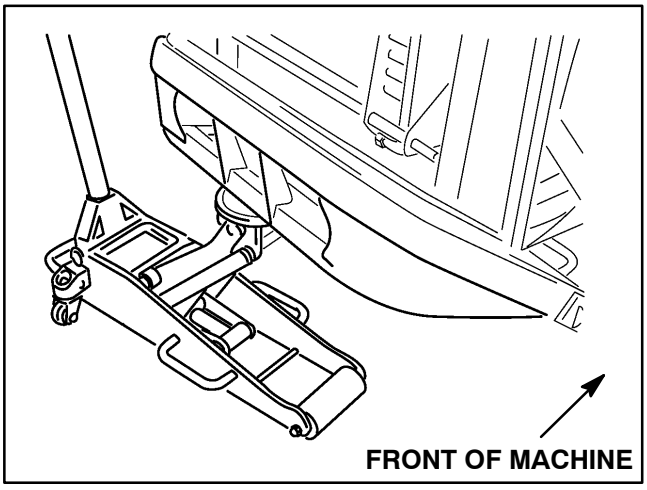

Figure 2

Chapter 2

Product Records and Maintenance

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Product Records

Insert a copy of the Operator's Manual and Parts Catalog for your Groundsmaster 7200 or 7210 at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your machine, insert the Installation Instructions, Operator's Manuals and Parts Catalogs for those options at the end of this chapter.

Maintenance

Maintenance procedures and recommended service intervals for the Groundsmaster 7200 and 7210 are covered in the Operator's Manuals. Refer to those publications when performing regular equipment maintenance.

Equivalents and Conversions

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm
1/64	0.015625	— 0.397	33/64	0.515625	— 13.097
1/32	0.03125	— 0.794	17/32	0.53125	— 13.494
3/64	0.046875	— 1.191	35/64	0.546875	— 13.891
1/16	0.0625	— 1.588	9/16	0.5625	— 14.288
5/64	0.078125	— 1.984	37/64	0.578125	— 14.684
3/32	0.09375	— 2.381	19/32	0.59375	— 15.081
7/64	0.109275	— 2.778	39/64	0.609375	— 15.478
1/8	0.1250	— 3.175	**5/8**	0.6250	— 15.875
9/64	0.140625	— 3.572	41/64	0.640625	— 16.272
5/32	0.15625	— 3.969	21/32	0.65625	— 16.669
11/64	0.171875	— 4.366	43/64	0.671875	— 17.066
3/16	0.1875	— 4.762	11/16	0.6875	— 17.462
13/64	0.203125	— 5.159	45/64	0.703125	— 17.859
7/32	0.21875	— 5.556	23/32	0.71875	— 18.256
15/64	0.234375	— 5.953	47/64	0.734375	— 18.653
1/4	0.2500	— 6.350	**3/4**	0.7500	— 19.050
17/64	0.265625	— 6.747	49/64	0.765625	— 19.447
9/32	0.28125	— 7.144	25/32	0.78125	— 19.844
19/64	0.296875	— 7.541	51/64	0.796875	— 20.241
5/16	0.3125	— 7.938	13/16	0.8125	— 20.638
21/64	0.328125	— 8.334	53/64	0.828125	— 21.034
11/32	0.34375	— 8.731	27/32	0.84375	— 21.431
23/64	0.359375	— 9.128	55/64	0.859375	— 21.828
3/8	0.3750	— 9.525	**7/8**	0.8750	— 22.225
25/64	0.390625	— 9.922	57/64	0.890625	— 22.622
13/32	0.40625	— 10.319	29/32	0.90625	— 23.019
27/64	0.421875	— 10.716	59/64	0.921875	— 23.416
7/16	0.4375	— 11.112	15/16	0.9375	— 23.812
29/64	0.453125	— 11.509	61/64	0.953125	— 24.209
15/32	0.46875	— 11.906	31/32	0.96875	— 24.606
31/64	0.484375	— 12.303	63/64	0.984375	— 25.003
1/2	0.5000	— 12.700	**1**	1.000	— 25.400

1 mm = 0.03937 in. **0.001 in. = 0.0254 mm**

U.S.to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
	Pounds/Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subract 32° 2. Multiply by 5/9

Torque Specifications

Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

These Torque Specifications for the installation and tightening of fasteners shall apply to all fasteners which do not have a specific requirement identified in this Service Manual. The following factors should be considered when applying torque: cleanliness of the fastener, use of a thread sealant (e.g. Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature (e.g. Nylock nut), hardness of the surface underneath the fastener's head or similar condition which affects the installation.

As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification

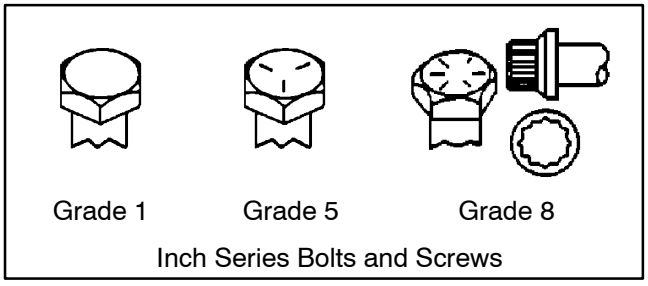

Figure 1

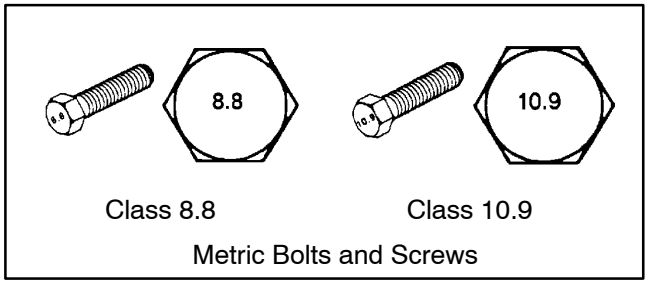

Figure 2

Using a Torque Wrench with an Offset Wrench

Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench calibration due to the effective change of torque wrench length. When using a torque wrench with an offset wrench, multiply the listed torque recommendation by the calculated torque conversion factor (Fig. 3) to determine proper tightening torque. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed torque recommendation.

Example: The measured effective length of the torque wrench (distance from the center of the handle to the center of the square drive) is 18".

The measured effective length of the torque wrench with the offset wrench installed (distance from the center of the handle to the center of the offset wrench) is 19".

The calculated torque conversion factor for this torque wrench with this offset wrench would be 18 / 19 = 0.947.

If the listed torque recommendation for a fastener is from 76 to 94 ft–lb, the proper torque when using this torque wrench with an offset wrench would be from 72 to 89 ft–lb.

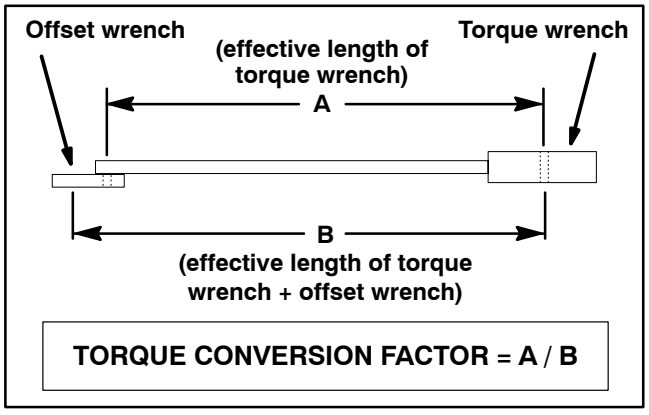

Figure 3

Standard Torque for Dry, Zinc Plated and Steel Fasteners (Inch Series)

Thread Size	Grade 1, 5 & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in–lb	**in–lb**	**N–cm**	**in–lb**	**N–cm**	**in–lb**	**N–cm**
# 6 – 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	169 ± 23	23 ± 3	262 ± 34
# 6 – 40 UNF				17 ± 2	192 ± 23	25 ± 3	282 ± 34
# 8 – 32 UNC	13 ± 2	25 ± 5	282 ± 56	29 ± 3	328 ± 34	41 ± 5	463 ± 56
# 8 – 36 UNF				31 ± 4	350 ± 45	43 ± 5	486 ± 56
# 10 – 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 5	475 ± 56	60 ± 6	678 ± 68
# 10 – 32 UNF				48 ± 5	542 ± 56	68 ± 7	768 ± 79
1/4 – 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1130 ± 113	140 ± 15	1582 ± 169
1/4 – 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 12	1299 ± 136	160 ± 17	1808 ± 192
5/16 – 18 UNC	115 ± 15	105 ± 15	1186 ± 169	200 ± 25	2260 ± 282	300 ± 30	3390 ± 339
5/16 – 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2542 ± 282	325 ± 33	3672 ± 373
	ft–lb	**ft–lb**	**N–m**	**ft–lb**	**N–m**	**ft–lb**	**N–m**
3/8 – 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 5	58 ± 7
3/8 – 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 4	47 ± 5	50 ± 6	68 ± 8
7/16 – 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16 – 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 6	75 ± 8	77 ± 8	104 ± 11
1/2 – 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 11	142 ± 15
1/2 – 20 UNF	32 ± 4	53 ± 7	72 ± 9	85 ± 9	115 ± 12	120 ± 12	163 ± 16
5/8 – 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 21	285 ± 28
5/8 – 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 18	230 ± 24	240 ± 24	325 ± 33
3/4 – 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 27	359 ± 37	375 ± 38	508 ± 52
3/4 – 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 30	407 ± 41	420 ± 43	569 ± 58
7/8 – 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 – 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 48	644 ± 65	667 ± 66	904 ± 89

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as engine oil or thread sealant such as Loctite.

Standard Torque for Dry, Zinc Plated and Steel Fasteners (Metric Fasteners)

Thread Size	Class 8.8 Bolts, Screws and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)	
M5 X 0.8	57 ± 6 in–lb	644 ± 68 N–cm	78 ± 8 in–lb	881 ± 90 N–cm
M6 X 1.0	96 ± 10 in–lb	1085 ± 113 N–cm	133 ± 14 in–lb	1503 ± 158 N–cm
M8 X 1.25	19 ± 2 ft–lb	26 ± 3 N–m	28 ± 3 ft–lb	38 ± 4 N–m
M10 X 1.5	38 ± 4 ft–lb	52 ± 5 N–m	54 ± 6 ft–lb	73 ± 8 N–m
M12 X 1.75	66 ± 7 ft–lb	90 ± 10 N–m	93 ± 10 ft–lb	126 ± 14 N–m
M16 X 2.0	166 ± 17 ft–lb	225 ± 23 N–m	229 ± 23 ft–lb	310 ± 31 N–m
M20 X 2.5	325 ± 33 ft–lb	440 ± 45 N–m	450 ± 46 ft–lb	610 ± 62 N–m

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value.

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as engine oil or thread sealant such as Loctite.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

Thread Size	Recommended Torque	
	Square Head	Hex Socket
1/4 – 20 UNC	140 ± 20 in–lb	73 ± 12 in–lb
5/16 – 18 UNC	215 ± 35 in–lb	145 ± 20 in–lb
3/8 – 16 UNC	35 ± 10 ft–lb	18 ± 3 ft–lb
1/2 – 13 UNC	75 ± 15 ft–lb	50 ± 10 ft–lb

Wheel Bolts and Lug Nuts

Thread Size	Recommended Torque**	
7/16 – 20 UNF Grade 5	65 ± 10 ft–lb	88 ± 14 N–m
1/2 – 20 UNF Grade 5	80 ± 10 ft–lb	108 ± 14 N–m
M12 X 1.25 Class 8.8	80 ± 10 ft–lb	108 ± 14 N–m
M12 X 1.5 Class 8.8	80 ± 10 ft–lb	108 ± 14 N–m

** For steel wheels and non–lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

Type 1, Type 23 or Type F	
Thread Size	Baseline Torque*
No. 6 – 32 UNC	20 ± 5 in–lb
No. 8 – 32 UNC	30 ± 5 in–lb
No. 10 – 24 UNC	38 ± 7 in–lb
1/4 – 20 UNC	85 ± 15 in–lb
5/16 – 18 UNC	110 ± 20 in–lb
3/8 – 16 UNC	200 ± 100 in–lb

Thread Cutting Screws (Zinc Plated Steel)

Thread Size	Threads per Inch		Baseline Torque*
	Type A	Type B	
No. 6	18	20	20 ± 5 in–lb
No. 8	15	18	30 ± 5 in–lb
No. 10	12	16	38 ± 7 in–lb
No. 12	11	14	85 ± 15 in–lb

* Hole size, material strength, material thickness & finish must be considered when determining specific torque values. All torque values are based on non–lubricated fasteners.

Conversion Factors

in–lb X 11.2985 = N–cm
ft–lb X 1.3558 = N–m

N–cm X 0.08851 = in–lb
N–m X 0.7376 = ft–lb

Chapter 3

Kubota Diesel Engine

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KUBOTA WORKSHOP MANUAL, DIESEL ENGINE, 05 SERIES

Specifications: Groundsmaster 7200

Item	Description
Make / Designation	Kubota D1105–E2B, 4–stroke, Liquid Cooled, OHV Diesel
Number of Cylinders	3
Bore x Stroke	3.07” x 3.09” (78 mm x 78.4 mm)
Total Displacement	68.53 in^3 (1123 cc)
Compression Ratio	22.0:1
Firing Order	1 (fan end) – 2 – 3 (flywheel end)
Dry Weight (approximate)	205 lb. (93 kg)
Fuel	No. 2–D Diesel Fuel (ASTM D975)
Fuel Injection Pump	Bosch MD Type Mini
Fuel Injector Nozzle	Mini Nozzle (DNOPD)
Fuel Tank Capacity	11.5 U.S. Gallons (43.5 Liters)
Governor	Centrifugal Mechanical
Low Idle Speed (no load)	1500 to 1650 RPM
High Idle Speed (no load)	3200 to 3250 RPM
Engine Oil	API Classification CH–4, CI–4 or Higher (see Operator’s Manual for viscosity recommendations)
Oil Pump	Gear Driven Trochoid Type
Crankcase Oil Capacity	4.0 U.S. Quarts (3.8 Liters) with Filter
Cooling System Capacity (including reserve tank)	6 U.S. Quarts (7.5 Liters)
Starter	12 VDC 1.4 KW
Alternator	12 VDC 40 Amp with Internal Regulator

Specifications: Groundsmaster 7210

Item	Description
Make / Designation	Kubota D1105T–E2B, 4–stroke, Turbocharged Liquid Cooled, OHV Diesel
Number of Cylinders	3
Bore x Stroke	3.07” x 3.09” (78 mm x 78.4 mm)
Total Displacement	68.53 in^3 (1123 cc)
Compression Ratio	22.0:1
Firing Order	1 (fan end) – 2 – 3 (flywheel end)
Dry Weight (approximate)	215 lb. (98 kg)
Fuel	No. 2–D Diesel Fuel (ASTM D975)
Fuel Injection Pump	Bosch MD Type Mini
Fuel Injector Nozzle	Mini Nozzle (DNOPD)
Fuel Tank Capacity	11.5 U.S. Gallons (43.5 Liters)
Governor	Centrifugal Mechanical
Low Idle Speed (no load)	1500 to 1650 RPM
High Idle Speed (no load)	3200 to 3250 RPM
Engine Oil	API Classification CH–4, CI–4 or Higher (see Operator’s Manual for viscosity recommendations)
Oil Pump	Gear Driven Trochoid Type
Crankcase Oil Capacity	4.0 U.S. Quarts (3.8 Liters) with Filter
Cooling System Capacity (including reserve tank)	6 U.S. Quarts (7.5 Liters)
Starter	12 VDC 1.4 KW
Alternator	12 VDC 40 Amp with Internal Regulator

General Information

This Chapter gives information about specifications, troubleshooting, testing and repair of the Kubota D1105 diesel engine used in the Groundsmaster 7200 and 7210. Refer to the Operator's Manual for engine maintenance information.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kubota Workshop Manual, Diesel Engine, 05 Series included at the end of this chapter. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Kubota engines are supplied through your Authorized Toro Distributor. If no parts list is available, be prepared to provide your distributor with the Toro equipment model and serial numbers as well as the Kubota engine model and serial numbers.

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance procedures and maintenance intervals for your Groundsmaster machine. Refer to that publication for additional information when servicing the machine.

Stopping the Engine (Groundsmaster 7210)

IMPORTANT: The engine used on the Groundsmaster 7210 is turbo–charged. Before stopping the engine after mowing or full load operation on Groundsmaster 7210 machines, cool the turbocharger by allowing the engine to idle at low speed for 5 minutes. Failure to do so may lead to turbocharger trouble.

Adjust Throttle Control

Proper throttle operation is dependent upon proper adjustment of throttle control. Make sure throttle control is operating properly.

1. Move remote throttle control lever to **FAST** position.

2. Check position of speed control lever on engine fuel injection pump. Speed control lever should be contacting high speed screw when throttle control lever is in **FAST** (detent) position (Fig. 1).

3. If necessary, position of throttle control cable jam nuts can be adjusted until speed control lever contacts high speed screw when throttle control lever is at **FAST** (detent) position (Fig. 2).

4. Make sure that cable jam nuts are fully tightened after adjustment.

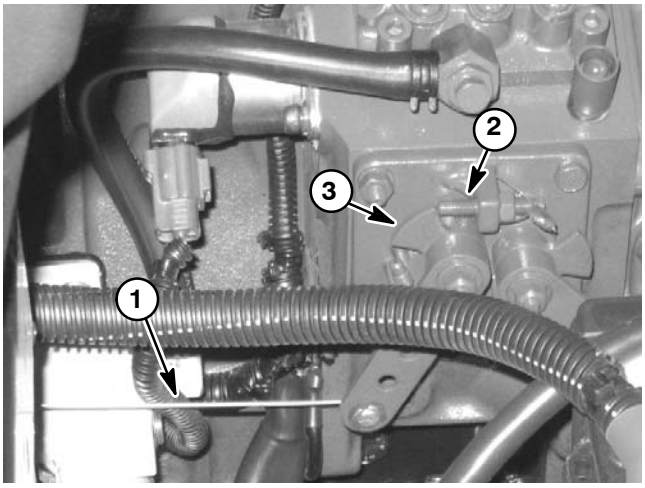

Figure 1

1. **Throttle cable**
2. **High speed screw**
3. **Speed control lever**

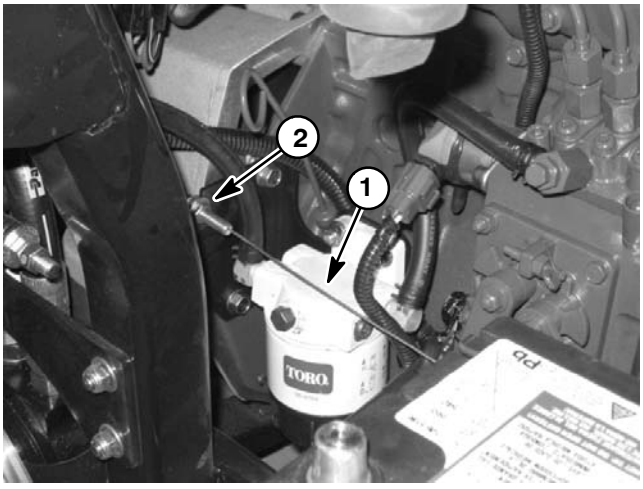

Figure 2

1. **Throttle cable**
2. **Cable jam nuts**

Air Cleaner Assembly

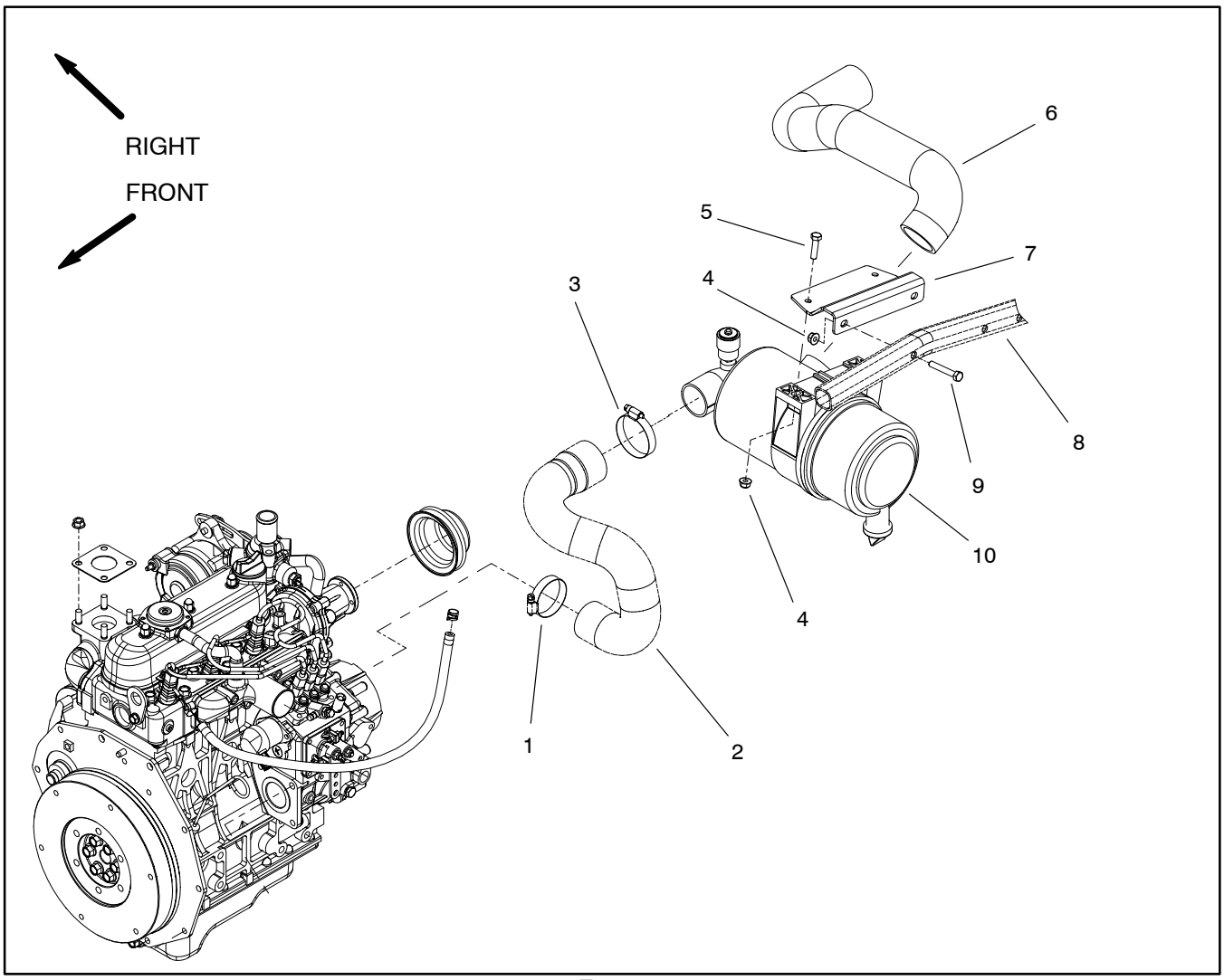

Figure 3

1. **Hose clamp**
2. **Inlet hose (GM 7200 shown)**
3. **Hose clamp**
4. **Flange nut (4 used)**
5. **Cap screw (2 used)**
6. **Air inlet hose**
7. **Air cleaner support**
8. **Frame**
9. **Cap screw (2 used)**
10. **Air cleaner assembly**

Removal (Fig. 3)

NOTE: See Operator's Manual for air cleaner maintenance procedures and intervals.

1. Park machine on a level surface, lower cutting unit (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Unlatch and raise hood.

3. Remove air cleaner components as needed using Figures 3 and 4 as guides.

4. Check air cleaner housing and cover for damage that could cause possible air leaks.

5. Check air inlet hoses for damage or wear.

Installation (Fig. 3)

IMPORTANT: Any leaks in the air filter system will allow dirt into engine and will cause serious engine damage. Make sure that all air cleaner components are in good condition and are properly secured during assembly.

1. Assemble air cleaner system using Figures 3 and 4 as guides.

   A. Make sure that vacuator valve is pointed down after assembly (Fig. 4).

   B. Make sure that inlet hose (item 2) has clearance around it at all points after air cleaner installation is completed.

   C. If indicator and nipple were removed from housing, apply sealant to threads of nipple before assembly.

2. Close and latch hood.

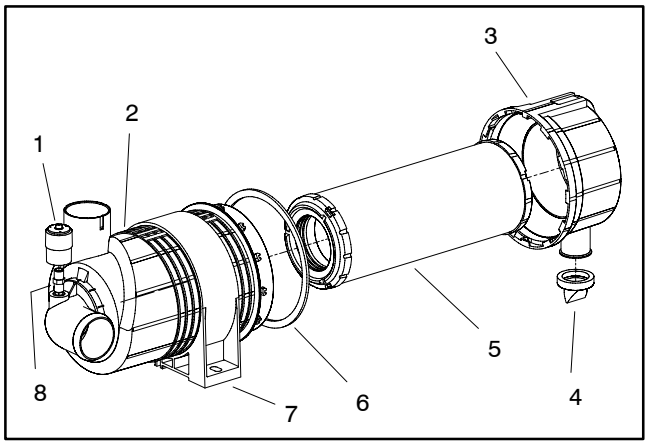

Figure 4

1. Indicator	**5. Air filter**
2. Housing	**6. Gasket**
3. Cover	**7. Bracket**
4. Vacuator valve	**8. Nipple**

Exhaust System

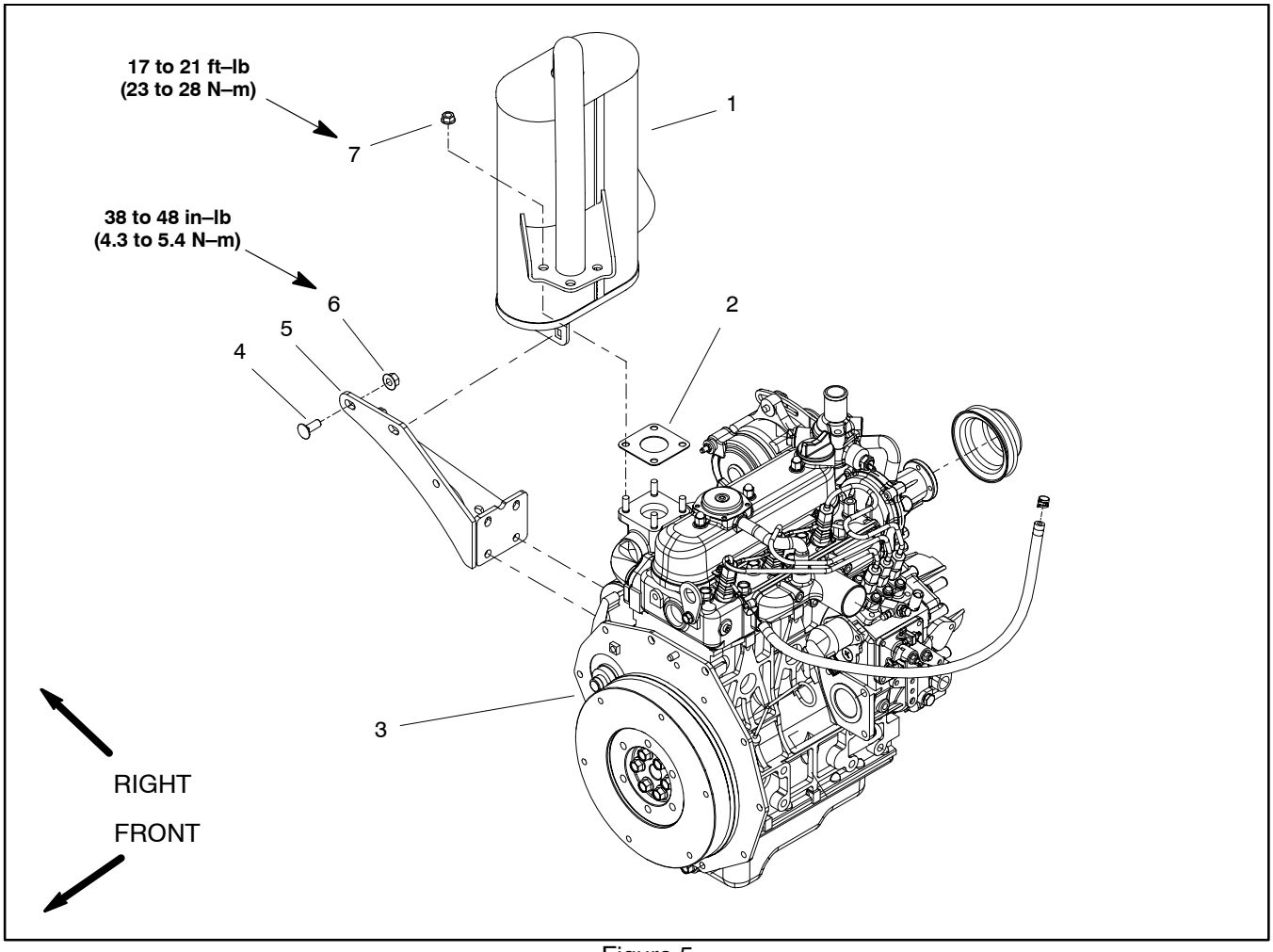

Figure 5

1. **Muffler (GM 7200 shown)**
2. **Exhaust gasket**
3. **Engine (GM 7200 shown)**
4. **Carriage screw (2 used)**
5. **Muffler bracket**
6. **Flange lock nut (2 used)**
7. **Flange nut (4 used)**

Removal (Fig. 5)

CAUTION

The engine and exhaust system may be hot. To avoid possible burns, allow the engine and exhaust system to cool before working on the exhaust system.

1. Park machine on a level surface, lower cutting unit (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Unlatch and raise hood.

3. Remove two (2) carriage screws and flange lock nuts that secure the muffler to the muffler bracket (Fig. 6).

4. Remove four (4) flange nuts from the exhaust manifold studs. Separate muffler flange from the engine exhaust manifold. Remove muffler from the machine.

5. Remove exhaust gasket. Replace gasket if damaged or torn.

Installation (Fig. 5)

NOTE: Make sure muffler flange and engine exhaust manifold sealing surfaces are free of debris or damage that may prevent a tight seal.

1. Place exhaust gasket on the engine exhaust manifold.

IMPORTANT: Finger tighten all fasteners before securing the muffler to the muffler bracket so there is no preload on the exhaust system.

2. Position muffler flange to the engine exhaust manifold and loosely install four (4) flange nuts.

3. With the muffler flange tight to the engine exhaust manifold (no gaps visible), position muffler so that muffler is tight against muffler bracket (no gaps visible).

4. Tighten four (4) flange nuts to secure muffler flange to exhaust manifold. Torque flange nuts **17 to 21 ft–lb (23 to 28 N–m)**.

5. Check that clearance between muffler and muffler bracket is less than 0.015” (0.4 mm). If necessary, repeat steps 3 and 4 above. Once clearance is less than 0.015” (0.4 mm), secure muffler to the muffler bracket by tightening two (2) carriage screws and flange lock nuts (Fig. 6). Torque lock nuts from **38 to 48 in–lb (4.3 to 5.4 N–m)**.

6. Close and latch hood.

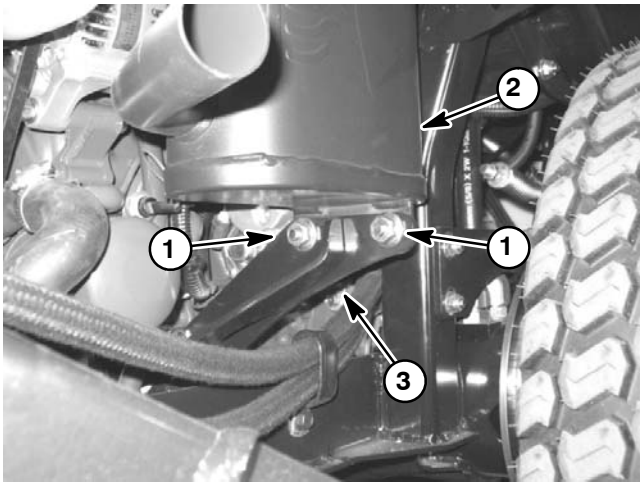

Figure 6

1. **Flange lock nut**
2. **Muffler**
3. **Muffler bracket**

Fuel System

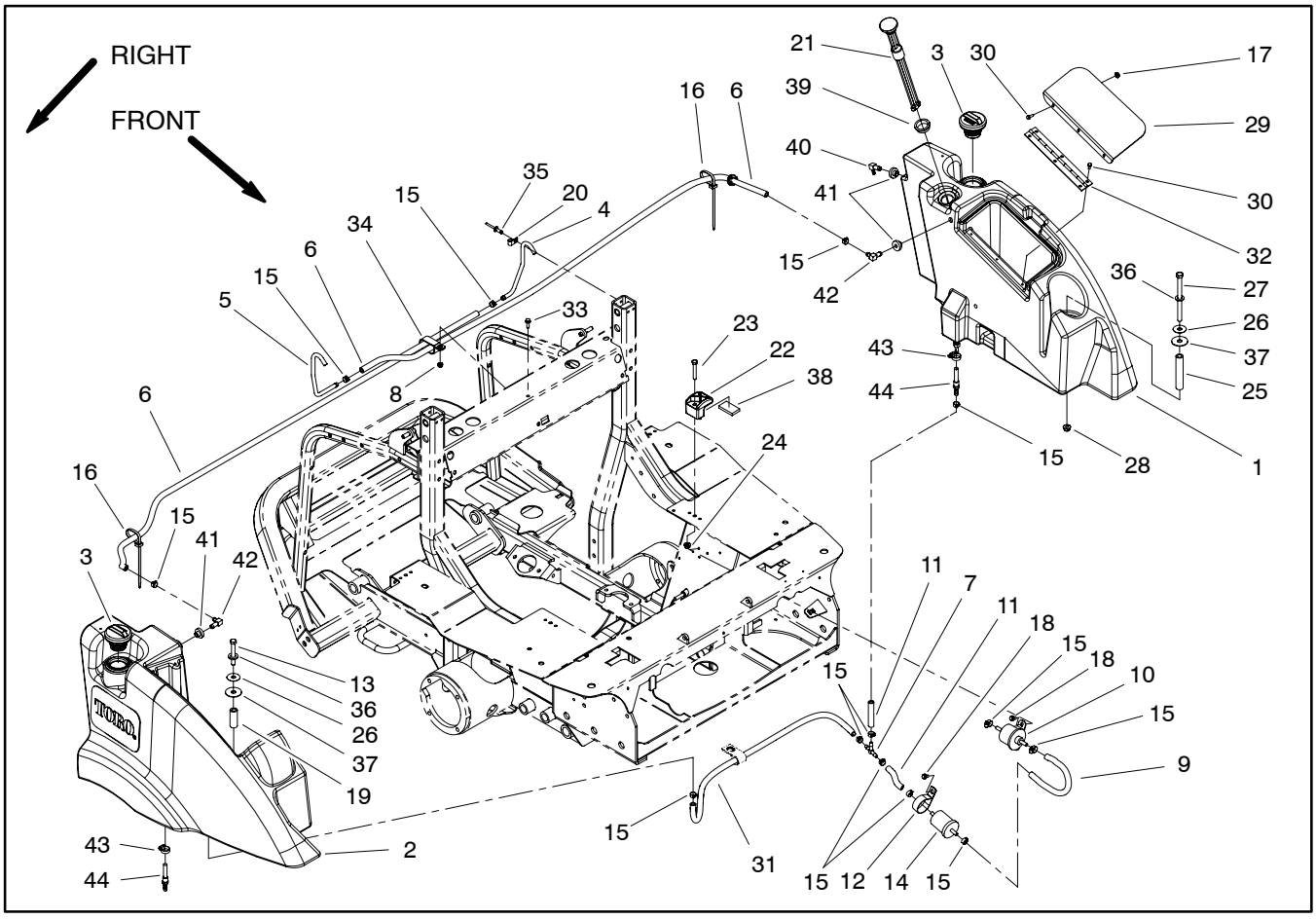

Figure 7

1. LH fuel tank
2. RH fuel tank
3. Fuel cap
4. LH vent tube
5. RH vent tube
6. Vent hose
7. Tee fitting
8. Flange nut
9. Fuel hose
10. Fuel pump
11. Fuel hose
12. R–clamp
13. Cap screw
14. Fuel filter
15. Hose clamp
16. Cable tie
17. Nut (3 used)
18. Washer head screw (3 used)
19. Spacer
20. R–clamp (2 used)
21. Fuel gauge
22. Clamp (4 used)
23. Cap screw (4 used)
24. Flange nut (4 used)
25. Spacer
26. Shield washer (2 used)
27. Cap screw
28. Flange nut (2 used)
29. Toolbox cover
30. Washer head screw (6 used)
31. Fuel hose
32. Hinge
33. Flange head screw
34. R–clamp
35. Rivet (2 used)
36. Flat washer (2 used)
37. Rubber washer (2 used)
38. Foam pad (4 used)
39. Grommet
40. Elbow fitting
41. Bushing (3 used)
42. Elbow fitting (2 used)
43. Hose clamp (2 used)
44. Strainer fitting (2 used)

DANGER

Use caution when storing or handling diesel fuel. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running or hot or when machine is in an enclosed area. Always fill fuel tank outside and clean up any spilled diesel fuel before starting the engine. Store fuel in a clean, safety–approved container and keep cap in place. Use diesel fuel for the engine only; not for any other purpose.

Check Fuel Lines and Connections

Check fuel lines and connections periodically as recommended in the Operator's Manual. Check lines for deterioration, damage, leakage or loose connections. Replace fuel lines, clamps and connections as needed.

Drain and Clean Fuel Tank

Drain and clean the fuel tank periodically as recommended in the Operator's Manual. Also, drain and clean the fuel tank if the fuel system becomes contaminated or if the machine is to be stored for an extended period.

To clean fuel tank, flush tank out with clean diesel fuel. Make sure tank is free of all contaminates and debris.

Fuel Tank Removal (Fig. 7)

1. Park machine on a level surface, lower cutting unit (or implement), stop engine, engage parking brake and remove key from the ignition switch. Unlatch and raise hood and operator seat.

NOTE: The fuel tanks on Groundsmaster 7200 and 7210 machines are connected to a common tee–fitting (item 7) under the seat. If either of the fuel tanks are to be removed from the machine, make sure that fuel is removed from both tanks before disconnecting any fuel hoses.

2. Use a fuel transfer pump to remove fuel from both fuel tanks.

3. To remove left side fuel tank:

   A. Loosen hose clamps and disconnect fuel return and vent hoses from fittings on left side fuel tank.

   B. Loosen and remove two (2) clamps (item 22) that secure fuel tank to frame.

   C. Loosen and remove cap screw (item 27), three (3) washers (items 36, 26 and 37) and flange nut (item 28) that secure fuel tank to frame. Locate and retrieve spacer (item 25).

   D. Loosen hose clamp and disconnect fuel supply hose from strainer (outlet) fitting on fuel tank.

   E. Lift left side fuel tank from machine.

4. To remove right side (RH) fuel tank:

   A. Loosen hose clamp and disconnect vent hose from fitting on RH fuel tank.

   IMPORTANT: When removing right side fuel tank, take care to not damage wire harness, electrical components or throttle cable.

   B. Loosen two (2) latches and remove control panel access cover. Position cover away from RH fuel tank.

   C. Remove five (5) flange head screws that secure control panel to RH fuel tank. Carefully position control panel away from RH fuel tank.

   D. Loosen and remove two (2) clamps (item 22) that secure RH fuel tank to frame.

   E. Loosen and remove cap screw (item 13), three (3) washers (items 36, 26 and 37), and flange nut (item 28) that secure RH fuel tank to frame. Locate and retrieve spacer (item 19).

   F. Loosen hose clamp and disconnect fuel supply hose from strainer (outlet) fitting on fuel tank.

   G. Lift RH fuel tank from machine.

5. If necessary, loosen hose clamp and remove strainer (outlet) fitting from fuel tank. Clean strainer with low pressure compressed air (50 PSI maximum pressure).

Fuel Tank Installation (Fig. 7)

1. If strainer (outlet) fitting was removed from fuel tank, clean threads and apply Loctite 30558 thread sealant (or equivalent) to threads of fitting. Install fitting into fuel tank. Install and torque hose clamp from **12 to 15 in–lb (1.4 to 1.6 N–m)** to secure fitting in tank.

2. Position fuel tank to the machine.

3. Secure tank to frame with two (2) clamps (item 22), spacer, cap screw, three (3) washers (items 36, 26 and 37) and flange nut.

4. Connect removed hoses to fuel tank fittings. Secure hoses with hose clamps.

5. If right side fuel tank was removed, carefully position control panel to fuel tank and secure with five (5) flange head screws. Install control panel access cover and secure with two (2) latches.

6. Lower and secure hood and operator seat. Fill fuel tanks.

Radiator

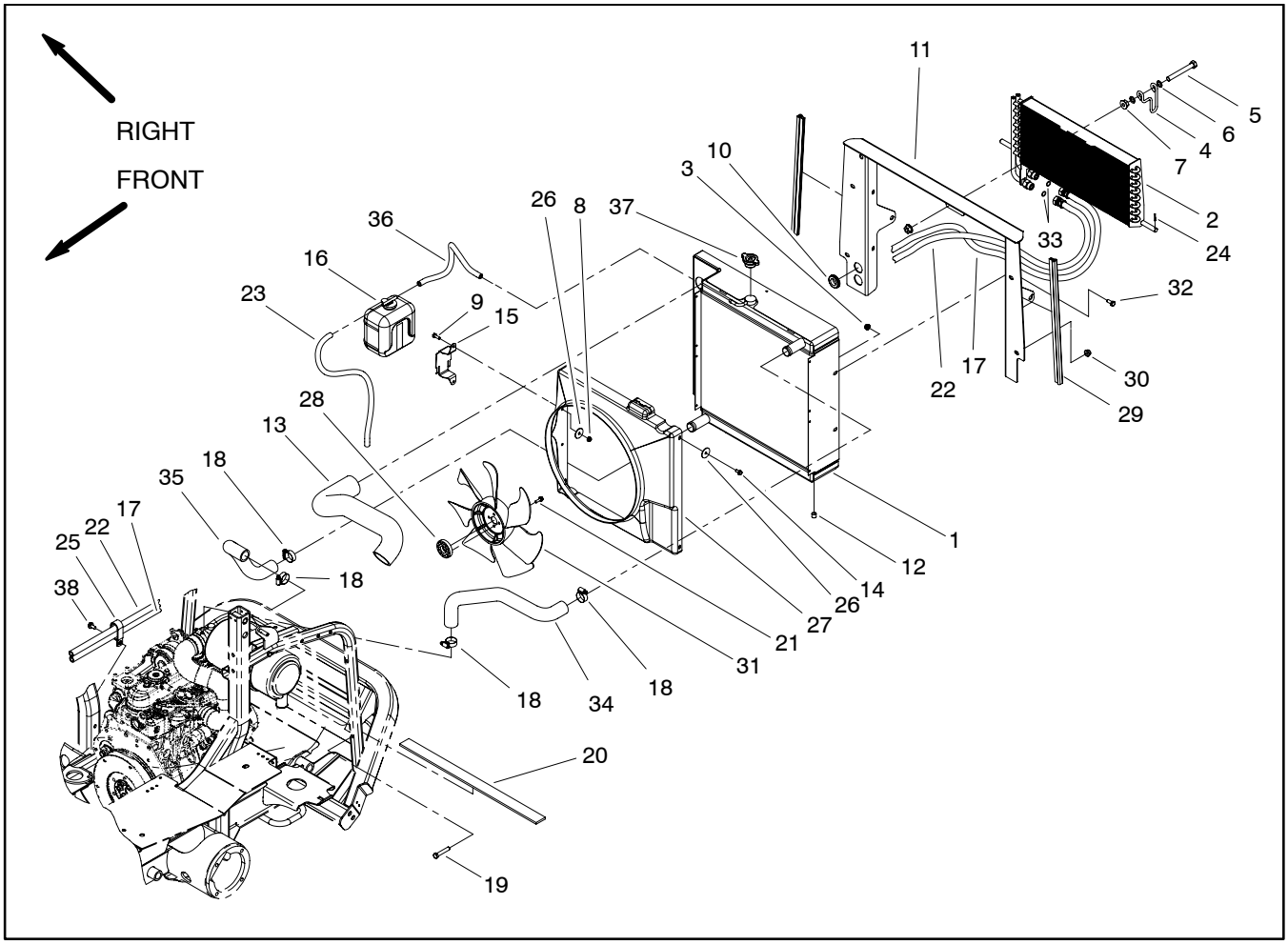

Figure 8

1. Radiator
2. Oil cooler
3. Flange nut (4 used)
4. Clamp
5. Cap screw
6. Washer (2 used)
7. Flange nut (2 used)
8. Flange nut (2 used)
9. Cap screw (2 used)
10. Rubber grommet (2 used)
11. Radiator frame
12. Pipe plug
13. Air inlet hose
14. Screw (4 used)
15. Overflow bottle bracket
16. Overflow bottle
17. Hydraulic hose
18. Hose clamp (4 used)
19. Cap screw (4 used)
20. Foam strip
21. Flange head screw (4 used)
22. Hydraulic hose
23. Hose
24. Roll pin
25. R–clamp
26. Flat washer (6 used)
27. Fan shroud
28. Fan spacer
29. Bulb seal (2 used)
30. Flange nut (4 used)
31. Cooling fan
32. Flange head screw (4 used)
33. O–ring
34. Upper radiator hose
35. Lower radiator hose
36. Hose
37. Radiator cap
38. Washer head screw

Removal (Fig. 8)

1. Park machine on a level surface, lower cutting unit (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Open hood and secure it in the raised position.

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns. Ethylene–glycol antifreeze is poisonous. Dispose of coolant properly or store it in a properly labeled container away from children and pets.

3. Place a suitable container under the left corner of the radiator to collect the coolant. Remove plug (item 12) (hex socket head) from bottom of the radiator and completely drain the radiator.

4. Disconnect following hoses from the radiator:

   A. Upper radiator hose to the water pump.

   B. Lower radiator hose to the engine block.

   C. Coolant hose to the expansion tank.

   D. Air inlet hose to the air cleaner assembly.

5. Remove four (4) screws and flat washers that secure fan shroud to radiator. Carefully position fan shroud away from radiator taking care to not damage fan.

6. Remove four (4) cap screws and flange nuts securing the radiator to the radiator frame.

7. Carefully pull radiator from the radiator frame and machine.

8. Plug radiator and hose openings to prevent contamination.

Installation (Fig. 8)

1. Remove all plugs placed in radiator and coolant hose openings during the removal procedure.

2. Carefully position radiator to the radiator frame.

3. Secure radiator to the radiator frame with four (4) cap screws and flange nuts.

4. Carefully position fan shroud to radiator taking care to not damage fan. Secure fan shroud to the radiator with four (4) screws and flat washers.

5. Make sure that equal clearance exists at all points between fan shroud and fan.

   A. To move fan shroud left or right, adjust location of radiator in radiator frame.

   B. To move fan shroud up or down, adjust location of shroud on radiator.

6. Connect following hoses to the radiator:

   A. Upper radiator hose to the water pump.

   B. Lower radiator hose to the engine block.

   C. Coolant hose to the expansion tank.

   D. Air inlet hose to the air cleaner assembly.

7. Apply thread sealant to threads of radiator plug (item 12). Install plug into radiator opening.

8. Check that no gaps exist between radiator, radiator frame and machine frame. If necessary, seal gaps with silicone caulk.

9. Fill radiator with coolant. Make sure that expansion tank coolant level is correct.

10. Close and latch hood.

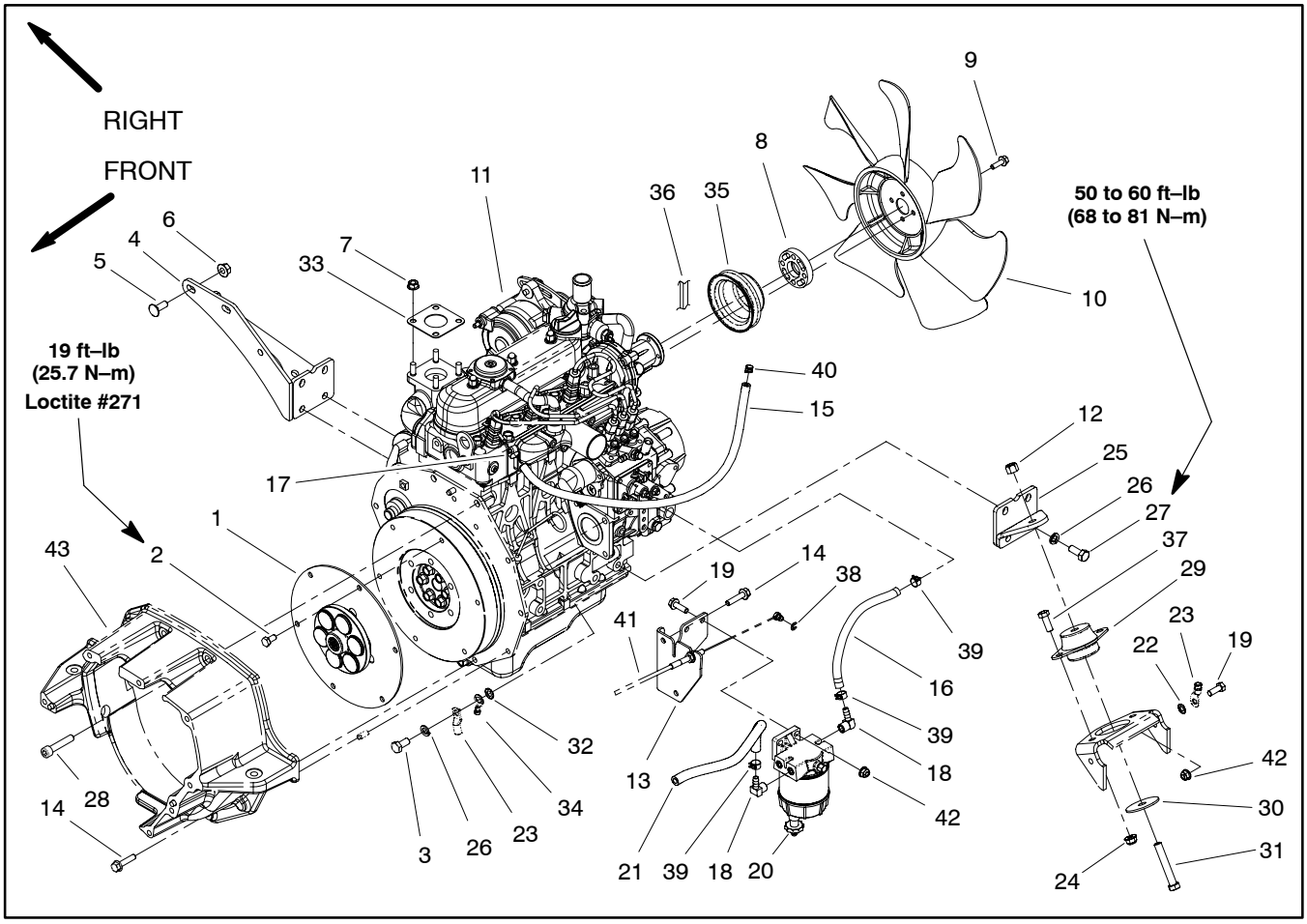

Figure 9

1. Flywheel coupling
2. Cap screw (6 used)
3. Cap screw
4. Muffler bracket
5. Carriage screw (2 used)
6. Flange lock nut (2 used)
7. Flange nut (4 used)
8. Fan spacer
9. Flange head screw (4 used)
10. Cooling fan
11. Engine (GM 7200 shown)
12. Lock nut (2 used)
13. Separator bracket
14. Flange head screw (8 used)
15. Fuel hose (return)
16. Fuel hose (supply)
17. Hose clamp
18. Elbow fitting (2 used)
19. Flange head screw (3 used)
20. Fuel/water separator
21. Fuel hose
22. Lock washer
23. Negative battery cable
24. Flange nut (4 used)
25. Rear mount
26. Lock washer (9 used)
27. Cap screw (8 used)
28. Socket head screw (2 used)
29. Engine mount (2 used)
30. Snubbing washer (2 used)
31. Cap screw (2 used)
32. Lock washer
33. Exhaust gasket
34. Wire harness ground
35. Fan pulley
36. V–belt
37. Cap screw (4 used)
38. E–ring
39. Hose clamp (3 used)
40. Hose clamp
41. Throttle cable
42. Flange nut (3 used)
43. Flywheel housing

Engine Removal (Fig. 9)

NOTE: When removing the engine using the following procedure, the flywheel housing and transmission will remain in the machine.

1. Park machine on a level surface, lower cutting unit (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Remove hood from machine (see Hood Removal in the Service and Repairs section of Chapter 6 – Chassis).

3. Raise and support operator seat.

4. Remove six (6) flange head screws that retain rear panel to frame (Fig. 10). Remove rear panel.

5. Remove air cleaner from the engine (see Air Cleaner Assembly Removal in this section).

6. Disconnect both battery cables at the battery. Disconnect negative cable first and then positive cable (see Battery Service in the Service and Repairs section of Chapter 5 – Electrical System).

7. Remove muffler from the engine (see Muffler Removal in this section).

8. Remove radiator from machine (see Radiator Removal in this section). Remove fan shroud.

9. Label all electrical wires for assembly purposes. Disconnect electrical wires from engine:

A. Negative battery cable, wire harness ground and fuel stop solenoid (Fig. 11).

B. Glow plug bus (Fig. 12).

C. High temperature warning switch and high temperature shutdown switch (Fig. 13).

D. Starter motor, fusible link harness, alternator and oil pressure switch.

10. Disconnect throttle cable from the throttle support bracket and swivel on the speed control lever. Position cable away from engine.

11. Disconnect fuel supply hose at injector pump (Fig. 11). Disconnect return fuel hose from front injector nozzle (Fig. 12). Plug and position disconnected hoses to prevent fuel leakage.

12. Note location of cable ties securing the wire harness to engine. Remove cable ties.

13. Support transmission to prevent it from moving during engine removal.

CAUTION

When removing engine assembly, make sure lift or hoist can safely support 250 pounds (114 kg).

14. Attach a suitable lift or hoist to lift tabs on front and rear of engine. Support engine with lift or hoist to prevent engine from shifting or moving.

15. Remove two (2) flange head screws that secure fuel/water separator bracket to engine. Remove bracket and separator from engine.

16. Remove six (6) flange head screws and two (2) socket head screws securing the flywheel housing to engine.

17. Remove lock nut, snubbing washer and cap screw that secures each side of engine to the engine mounts attached to the frame.

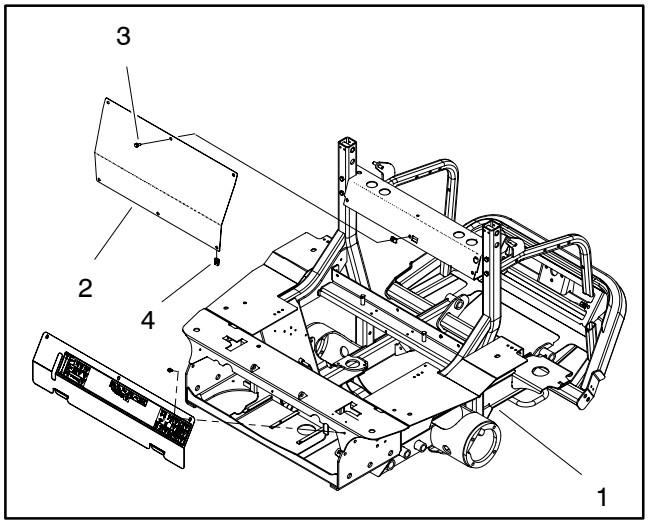

Figure 10

1. Machine frame
2. Rear panel
3. Flange screw (6 used)
4. Clip (6 used)

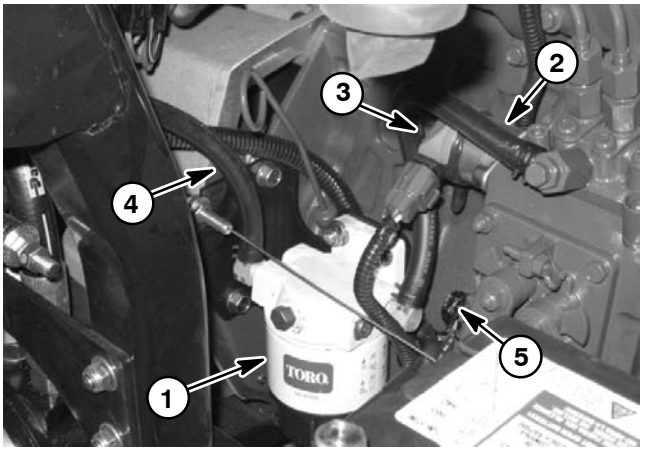

Figure 11

1. Fuel/water separator
2. Fuel supply hose
3. Fuel stop solenoid
4. Fuel hose from pump
5. Ground connections

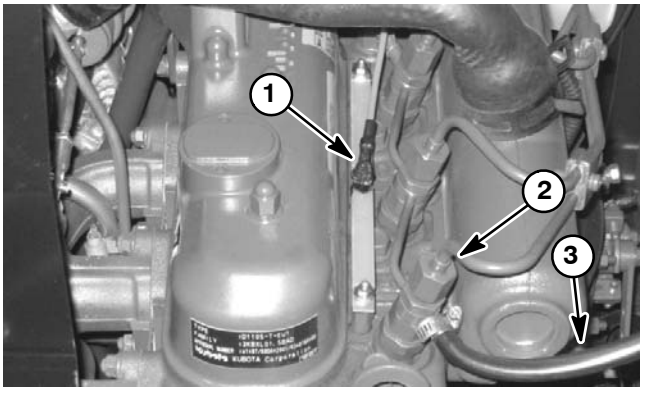

Figure 12

1. Glow plug wire
2. Front injector nozzle
3. Return fuel hose

IMPORTANT: Make sure to not damage the engine, flywheel housing, fuel hoses, hydraulic lines, electrical harness or other parts while removing engine. Also, make sure that transmission does not shift during engine removal.

CAUTION

One person should operate lift or hoist while a second person guides the engine assembly out of the machine.

18. Move engine toward the rear of the machine to separate it from the transmission input shaft and flywheel housing. Carefully raise engine from the machine.

19. Locate and retrieve two (2) dowel pins that locate flywheel housing to engine.

20. If necessary, remove six (6) cap screws that secure flywheel coupling to engine flywheel and remove coupling from engine.

21. If necessary, remove engine mount and muffler bracket from engine.

Engine Installation (Fig. 9)

1. Make sure that all engine components removed during maintenance or rebuilding are installed to the engine.

2. If removed, install engine mount and muffler bracket to engine with cap screws and lock washers. Torque cap screws from **50 to 60 ft–lb (68 to 81 N–m)**.

3. If flywheel coupling was removed from engine, apply Loctite #271 (or equivalent) to threads of six (6) cap screws and secure coupling to engine flywheel. Torque cap screws **19 ft–lb (25.7 N–m)**.

4. Position two (2) dowel pins to engine endplate.

5. Support transmission to prevent it from moving during engine installation.

CAUTION

When installing engine assembly, make sure lift or hoist can safely support 250 pounds (114 kg).

6. Connect lift or hoist to the front and rear engine lift tabs.

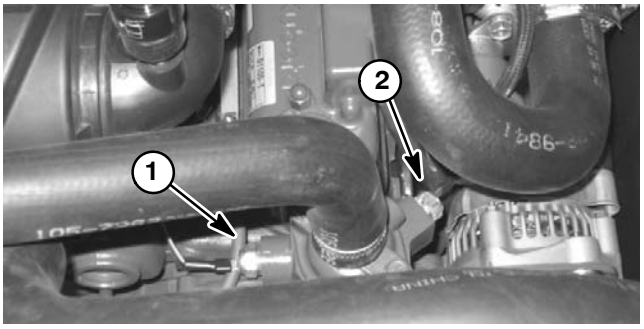

Figure 13

1. **Temp shutdown switch** 2. **Temp warning switch**

CAUTION

One person should operate lift or hoist while a second person guides the engine assembly into the machine.

IMPORTANT: Make sure to not damage the engine, flywheel housing, fuel or hydraulic lines, electrical harness or other parts while installing the engine. Also, make sure that transmission does not shift during engine installation.

7. Carefully lower engine assembly into the machine. Move engine toward the front of the machine while aligning flywheel coupling to transmission input shaft and engine endplate to flywheel housing.

8. Secure flywheel housing and fuel/water separator bracket to engine endplate with eight (8) flange head screws and two (2) socket head screws.

9. Secure engine to the engine mounts attached to the frame with two (2) cap screws, snubbing washers and lock nuts.

10. Connect fuel hoses to the fuel/water separator (Fig. 11). Connect return fuel hose to front injector nozzle (Fig. 12).

11. Connect electrical wires to engine using labels placed during engine removal:

A. Negative battery cable, wire harness ground and fuel stop solenoid (Fig. 11).

B. Glow plug bus (Fig. 12).

C. High temperature warning switch and high temperature shutdown switch (Fig. 13).

D. Starter motor, fusible link harness, alternator and oil pressure switch.

12. Secure wire harness to engine with cable ties at locations noted during engine removal.

13. Carefully position fan shroud around the engine fan.

14. Install radiator to machine (see Radiator Installation in this section). Make sure that radiator hoses are secured with hose clamps.

15. Make sure that drain plug is installed in radiator. Fill radiator with coolant.

16. Install muffler to the engine (see Exhaust System Installation in this section).

17. Connect throttle cable to the support bracket and swivel on the speed control lever.

18. Adjust throttle cable (see Adjust Throttle Cable in the Adjustments section of this chapter).

19. Connect and secure positive battery cable to the battery. Then connect negative battery cable.

20. Install air cleaner to the engine (see Air Cleaner Assembly Installation in this section).

21. Check engine oil level and adjust as needed.

22. Secure rear panel to frame with six (6) flange head screws (Fig. 10).

23. Install hood to the machine (see Hood Installation in the Service and Repairs section of Chapter 6 – Chassis).

24. Bleed fuel system.

25. Close and latch hood. Lower operator seat.

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Chapter 4

Hydraulic System

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PARKER TORQMOTOR™ SERVICE PROCEDURE (TC, TB, TE, TJ, TF, TG, TH AND TL SERIES)

Specifications

Item	Description
Transmission	Kanzaki dual, variable displacement traction piston pumps with integral charge pump and multi–disc PTO clutch
Maximum Traction Pump Displacement (per revolution)	1.1 Cubic Inches (18 cc)
Traction Circuit Relief Pressure (Forward and Reverse)	4000 PSI (276 bar)
Charge Pump Displacement (per revolution)	0.37 Cubic Inches (6 cc)
Charge Pressure	70 to 100 PSI (4.8 to 6.9 bar)
Gear Pump	Casappa single section, positive displacement gear type pump
Displacement (per revolution)	0.41 Cubic Inches (6.7 cc)
Implement Relief Pressure	3000 PSI (207 bar)
Wheel Motors	Parker orbital rotor motor, TG Series
Displacement (per revolution)	19.0 Cubic Inches (310 cc)
Hydraulic Filter	Spin–on cartridge type
Hydraulic Oil Capacities (Approximate)	
Hydraulic Oil Change (Hydraulic Tank and Transmission)	10.9 Qt. U.S. (10.3 L)
Hydraulic System (All Components and Lines)	16 Qt. U.S. (15.1 L)
Hydraulic Oil	See Operator's Manual

Hydraulic Hoses

Hydraulic hoses are subject to extreme conditions such as pressure differentials during operation and exposure to weather, sun, chemicals, very warm storage conditions or mishandling during operation and maintenance. These conditions can cause hose damage and deterioration. Some hoses are more susceptible to these conditions than others. Inspect all machine hydraulic hoses frequently for signs of deterioration or damage:

Hard, cracked, cut, abraded, charred, leaking or otherwise damaged hose.

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint (layline) on the hose. Use two wrenches; hold the hose straight with one wrench and tighten the hose swivel nut onto the fitting with the other wrench (See Hydraulic Hose and Tube Installation in this section). If the hose has an elbow at one end, tighten the swivel nut on that end before tightening the nut on the straight end of the hose.

For additional hydraulic hose information, refer to Toro Service Training Book, Hydraulic Hose Servicing (Part Number 94813SL).

WARNING

Before disconnecting or performing any work on hydraulic system, relieve all pressure in system (see Relieving Hydraulic System Pressure in this section).

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

Hydraulic Hose and Tube Installation (O–Ring Face Seal Fitting)

1. Make sure threads and sealing surfaces of the hose/tube and the fitting are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the face seal O–ring be replaced any time the connection is opened. Make sure the O–ring is installed and properly seated in the fitting groove. Lightly lubricate the O–ring with clean hydraulic oil.

3. Place the hose/tube against the fitting body so that the flat face of the hose/tube sleeve fully contacts the O–ring in the fitting.

4. Thread the swivel nut onto the fitting by hand. While holding the hose/tube with a wrench, use a torque wrench to tighten the swivel nut to the recommended installation torque shown in Figure 3. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 – Product Records and Maintenance).

5. If a torque wrench is not available or if space at the swivel nut prevents use of a torque wrench, an alternate method of assembly is the Flats From Wrench Resistance (F.F.W.R.) method (Fig. 2).

A. Using a wrench, tighten the swivel nut onto the fitting until light wrench resistance is reached (approximately 30 in–lb).

B. Mark the swivel nut and fitting body. Hold the hose/tube with a wrench to prevent it from turning.

C. Use a second wrench to tighten the nut to the correct Flats From Wrench Resistance (F.F.W.R.). The markings on the nut and fitting body will verify that the connection has been properly tightened.

Size	F.F.W.R.
4 (1/4 in. nominal hose or tubing)	1/2 to 3/4
6 (3/8 in.)	1/2 to 3/4
8 (1/2 in.)	1/2 to 3/4
10 (5/8 in.)	1/2 to 3/4
12 (3/4 in.)	1/3 to 1/2
16 (1 in.)	1/3 to 1/2

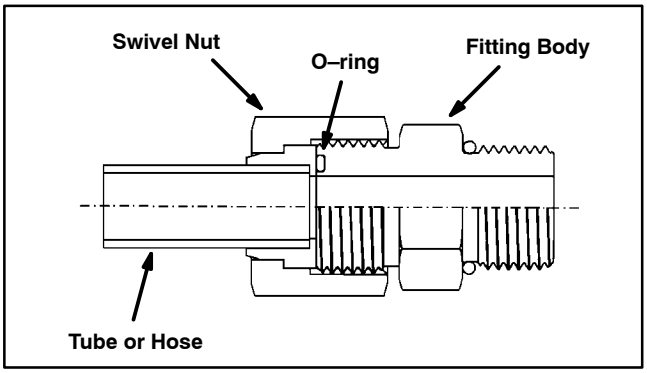


Figure 1

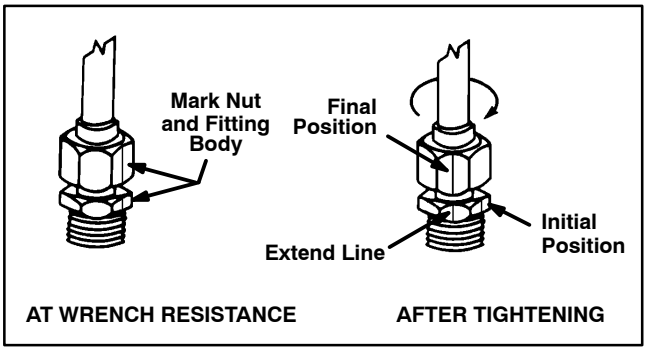


Figure 2

Fitting Dash Size	Hose/Tube Side Thread Size	Installation Torque
4	9/16 – 18	18 to 22 ft–lb (25 to 29 N–m)
6	11/16 – 16	27 to 33 ft–lb (37 to 44 N–m)
8	13/16 – 16	37 to 47 ft–lb (51 to 63 N–m)
10	1 – 14	60 to 74 ft–lb (82 to 100 N–m)
12	1 3/16 – 12	85 to 105 ft–lb (116 to 142 N–m)
16	1 7/16 – 12	110 to 136 ft–lb (150 to 184 N–m)
20	1 11/16 – 12	140 to 172 ft–lb (190 to 233 N–m)

Figure 3

Hydraulic Fitting Installation (SAE Straight Thread O–Ring Fitting into Component Port)

Non–Adjustable Fitting (Fig. 4)

1. Make sure all threads and sealing surfaces of fitting and component port are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the O–ring be replaced any time the connection is opened.

3. Lightly lubricate the O–ring with clean hydraulic oil. Fitting threads should be clean with no lubricant applied.

IMPORTANT: Before installing fitting into port, determine port material. If fitting is to be installed into an aluminum port, installation torque is reduced.

4. Install the fitting into the port. Then, use a torque wrench and socket to tighten the fitting to the recommended installation torque shown in Figure 5.

NOTE: Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be less than the recommended installation torque. See Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 – Product Records and Maintenance to determine necessary conversion information.

5. If a torque wrench is not available, or if space at the port prevents use of a torque wrench, an alternate method of assembly is the Flats From Finger Tight (F.F.F.T.) method.

A. Install the fitting into the port and tighten it down full length until finger tight.

B. If port material is steel, tighten the fitting to the listed F.F.F.T. If port material is aluminum, tighten fitting to 60% of listed F.F.F.T.

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

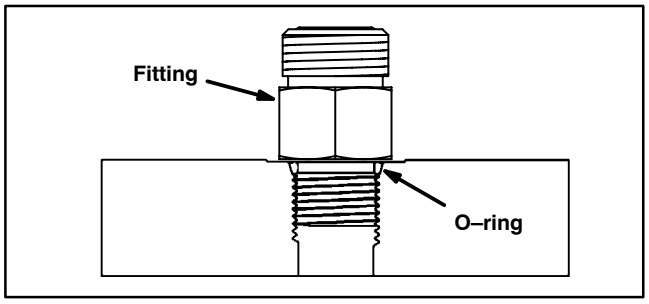


Figure 4

Fitting Dash Size	Fitting Port Side Thread Size	Installation Torque Into Steel Port	Installation Torque Into Aluminum Port
4	7/16 – 20	15 to 19 ft–lb (21 to 25 N–m)	9 to 11 ft–lb (13 to 15 N–m)
5	1/2 – 20	18 to 22 ft–lb (25 to 29 N–m)	11 to 15 ft–lb (15 to 20 N–m)
6	9/16 – 18	34 to 42 ft–lb (47 to 56 N–m)	20 to 26 ft–lb (28 to 35 N–m)
8	3/4 – 16	58 to 72 ft–lb (79 to 97 N–m)	35 to 43 ft–lb (48 to 58 N–m)
10	7/8 – 14	99 to 121 ft–lb (135 to 164 N–m)	60 to 74 ft–lb (82 to 100 N–m)
12	1 1/16 – 12	134 to 164 ft–lb (182 to 222 N–m)	81 to 99 ft–lb (110 to 134 N–m)
14	1 3/16 – 12	160 to 196 ft–lb (217 to 265 N–m)	96 to 118 ft–lb (131 to 160 N–m)
16	1 5/16 – 12	202 to 248 ft–lb (274 to 336 N–m)	121 to 149 ft–lb (165 to 202 N–m)
20	1 5/8 – 12	247 to 303 ft–lb (335 to 410 N–m)	149 to 183 ft–lb (202 to 248 N–m)

Figure 5

Adjustable Fitting (Fig. 6)

1. Make sure all threads and sealing surfaces of fitting and component port are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the O–ring be replaced any time the connection is opened.

3. Lightly lubricate the O–ring with clean hydraulic oil. Fitting threads should be clean with no lubricant applied.

4. Turn back the lock nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1 in Figure 7).

IMPORTANT: Before installing fitting into port, determine port material. If fitting is to be installed into an aluminum port, installation torque is reduced.

5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2).

6. To put the fitting in the desired position, unscrew it by the required amount, but no more than one full turn (Step 3).

7. Hold the fitting in the desired position with a wrench and use a torque wrench to tighten the fitting to the recommended installation torque shown in Figure 5. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 – Product Records and Maintenance).

8. If a torque wrench is not available, or if space at the port prevents use of a torque wrench, an alternate method of assembly is the Flats From Finger Tight (F.F.F.T.) method. Hold the fitting in the desired position with a wrench and, if port material is steel, tighten the lock nut with a second wrench to the listed F.F.F.T (Step 4). If port material is aluminum, tighten fitting to 60% of listed F.F.F.T.

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

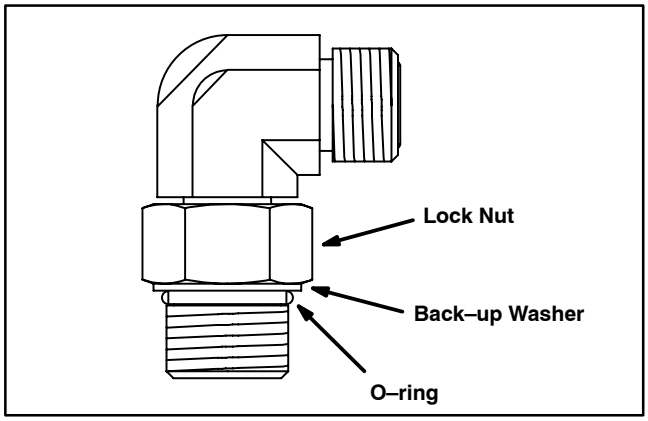


Figure 6

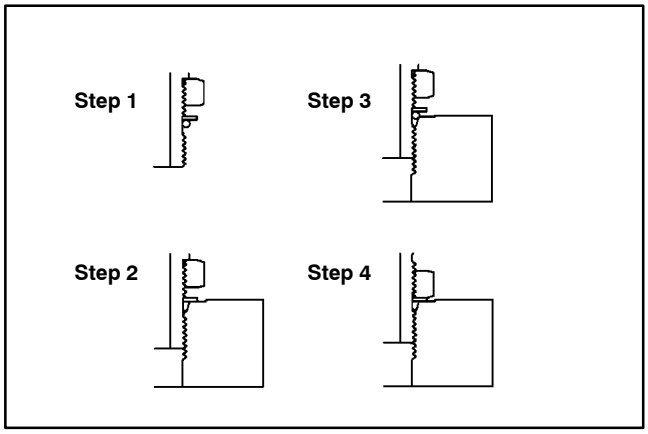


Figure 7

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance procedures and maintenance intervals for your Groundsmaster machine. Refer to that publication for additional information when servicing the machine.

Pushing Traction Unit

In case of emergency, your Groundsmaster can be pushed for a very short distance. However, Toro does not recommend this as a standard procedure.

1. Locate two (2) by–pass valves on transmission (Fig. 8). Loosen (rotate counterclockwise) both of the valves from one (1) to two (2) turns.

IMPORTANT: Do not push the machine faster than 2 mph because the drive system may be damaged. If machine must be moved a considerable distance (more than a few feet), transport it on a truck or trailer.

2. Slowly push machine.

3. Before starting engine, tighten both by–pass valves to close them. Torque valves from **62 to 79 in–lb (7 to 9 N–m)**. Do not start engine when by–pass valves are open.

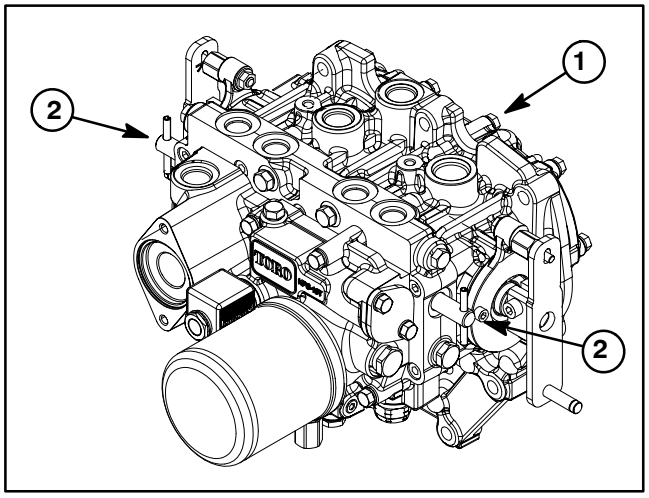


Figure 8

1. **Transmission**
2. **By–pass valve**

Relieving Hydraulic System Pressure

Before disconnecting or performing any work on the Groundsmaster 7200 and 7210 hydraulic system, all pressure in the hydraulic system must be relieved.

To relieve hydraulic pressure in the traction circuit, park machine on a level surface with the cutting deck (or implement) lowered and off. Turn key switch to OFF and allow engine to stop. If machine is parked on an incline or slope, pressure in the traction circuit WILL NOT be relieved.

To relieve hydraulic pressure in lift circuit, fully lower the cutting deck (or implement) onto solid blocks. Turn key switch to OFF and allow engine to stop. Make sure that after lowering, the cutting deck (or implement) is not being supported by the lift cylinder.

Traction Circuit (Closed Loop) Component Failure

The traction system on Groundsmaster 7200 and 7210 machines consists of two identical and independent closed loop traction circuits. If a component in one of these traction circuits (e.g. wheel motor or transmission piston pump) should fail, debris and contamination from the failed component will circulate throughout the traction circuit. This contamination can damage other components in the circuit so it must be removed to prevent additional component failure.

If a component failure occurs in one of the traction circuits, it is critical to disassemble, drain and thoroughly clean the entire traction circuit (transmission piston pump, hydraulic hoses and wheel motor). This procedure will ensure that all contamination is removed from the circuit. If any debris remains in the traction circuit and the machine is operated, the debris can cause additional component failure.

An additional step for removing all traction circuit contamination would be to temporarily install a high pressure hydraulic oil filter (see Special Tools) into the circuit. The filter could be used when connecting hydraulic test gauges in order to test traction circuit components or after replacing a failed traction circuit component (e.g. wheel motor or transmission piston pump). The filter will ensure that contaminates are removed from the closed loop and thus, do not cause additional component damage.

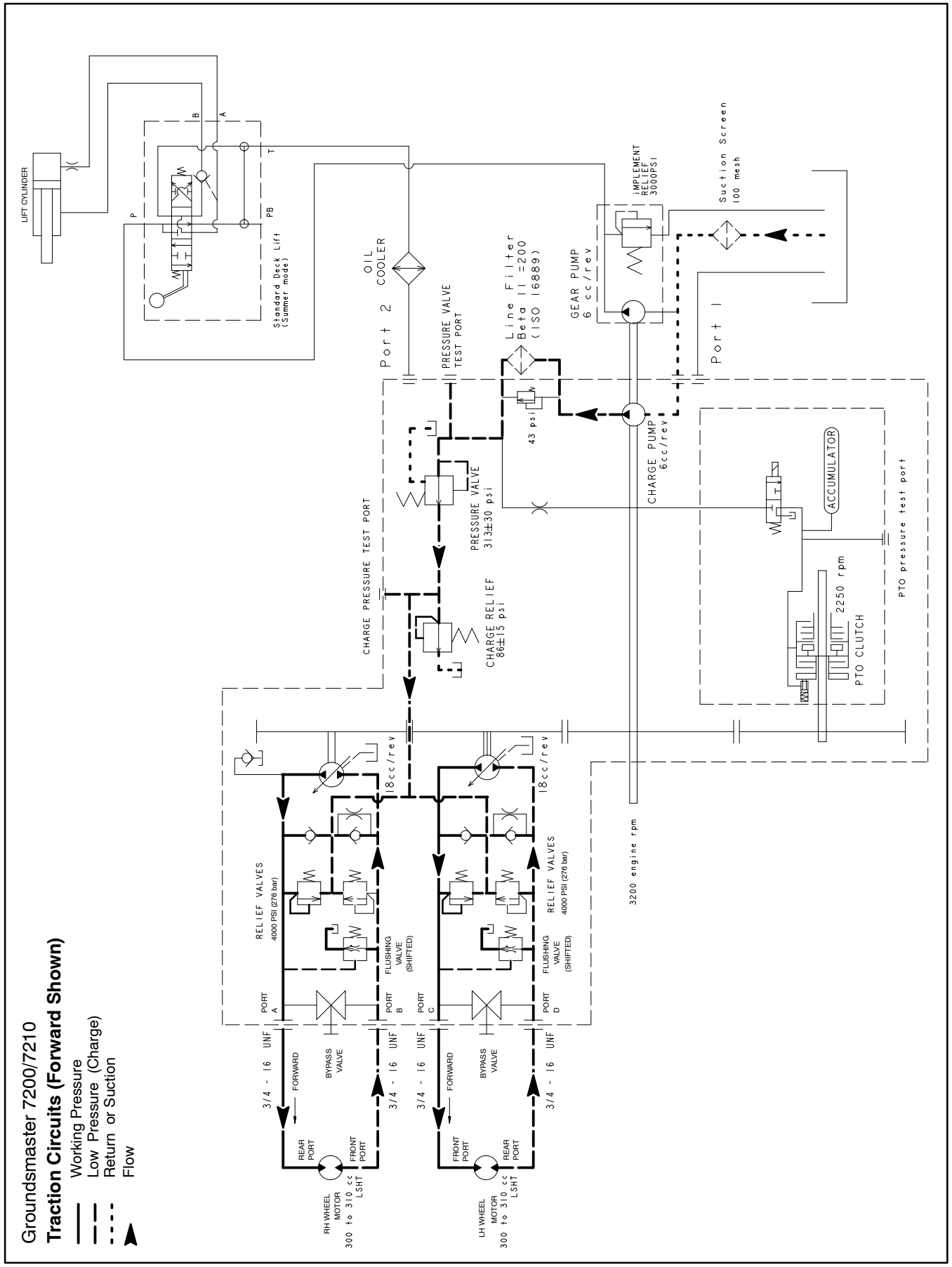
Once the filter has been placed in the traction circuit, place the machine on jack stands and operate the traction circuit to allow oil flow through the circuit. With the machine raised off the ground, the traction circuit will have maximum oil flow at minimum pressure to minimize damage from any remaining contamination. The filter will remove contamination from the closed loop traction circuit during operation. Remove the filter from the machine after contamination has been removed from the traction circuit.

IMPORTANT: When operating the traction system with the high pressure filter installed, make sure that flow is always directed through the filter (e.g. do not move the traction levers in the reverse direction if the filter is placed for forward direction flow). If flow is reversed, debris from the filter will re–enter the traction circuit.

Hydraulic Schematics

The hydraulic schematics for the Groundsmaster 7200 and 7210 are located in Chapter 8 – Foldout Diagrams.

Hydraulic Flow Diagrams



Traction Circuits

The Groundsmaster traction system consists of a transmission that is directly coupled to, and driven by, the engine flywheel. The transmission provides two identical and independent closed loop traction circuits: one for the right wheel motor and one for the left wheel motor. Each of these transmission circuits include a variable displacement, slipper foot design piston pump which provides hydraulic flow for one wheel motor. The swash plate in each of the piston pumps is controlled by one of the operator traction levers.

The angle of the swash plate determines pump flow and ultimately traction speed. When a traction lever is moved a small amount, a small swash plate rotation results in low pump output and lower traction speed. When the traction lever is moved fully, the pump swash plate rotates fully to provide maximum pump output flow and traction speed.

Because hydraulic flow to each rear wheel is determined by traction lever movement and subsequent swash plate position, steering is accomplished by moving the two traction levers a different amount or direction.

With the engine running and the traction levers in the neutral position, the piston pump swash plates are held in the vertical position, providing no flow to either wheel motor and the machine remains stationary. The transmission reverse check valves include an orifice which makes it easier to locate the transmission neutral position.

Forward

When a traction lever is pushed forward, the rod connected to the traction lever positions the swash plate in the piston pump to provide oil flow from the transmission (port A for the RH side or C for the LH side). This oil flows to the wheel motor and turns the motor in the forward direction. Oil flow from the wheel motor returns to the transmission (port B or D) and is continuously pumped as long as the traction lever is pushed forward.

As the traction load increases, forward traction circuit pressure can increase to the relief valve setting of 4000 PSI (276 bar). If pressure exceeds the relief setting, oil flows through the forward relief valve in the transmission to the low pressure side of the closed loop traction circuit.

The piston pumps use a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across pump parts into the transmission case drain. This leakage results in the loss of hydraulic fluid from the closed loop traction circuits that must be replenished.

A charge pump in the transmission supplies hydraulic flow for maintaining 70 to 100 PSI (4.8 to 6.9 bar) to the low pressure side of both of the traction circuits. The charge pump also provides pressure for the transmission PTO drive system. The charge pump replenishes the closed loop traction circuits with fluid from the hydraulic tank. The charge relief valve in the transmission maintains sufficient pressure so that charge pump flow is guided past check valves to the low pressure side of each traction circuit. Charge pump flow in excess of system requirements is relieved through the charge relief valve back to the hydraulic tank.

Both of the transmission traction circuits include a flushing valve that bleeds off a small amount of hydraulic fluid for cooling of the closed loop traction circuits. The flushing valves are opened only during forward direction operation. When the flushing valves are unseated, some oil from the low pressure side of the traction loop is returned to the hydraulic tank. Oil loss from the closed loop due to the flushing valve is replenished by the charge pump.

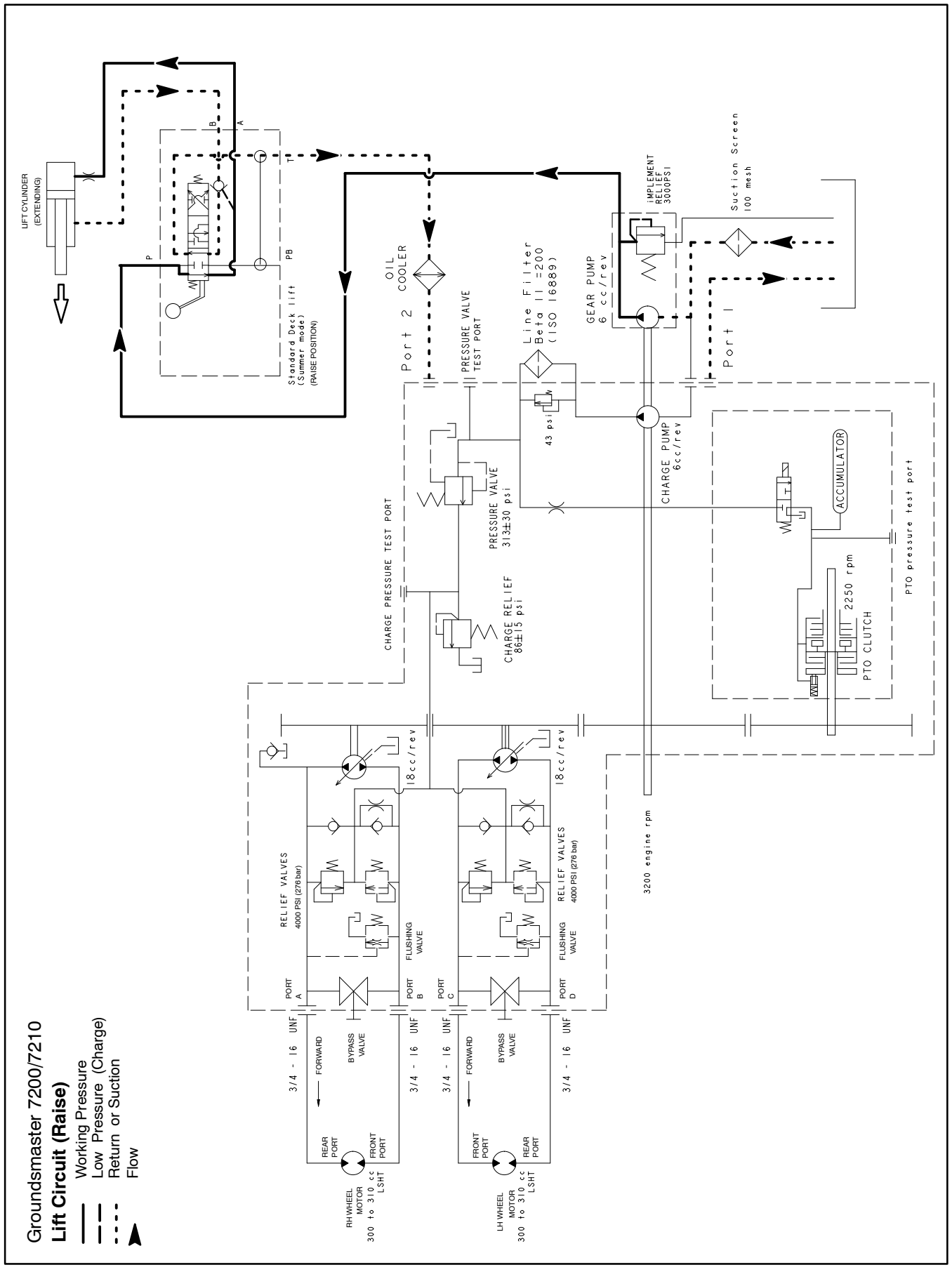
Reverse

The traction circuit operates essentially the same in reverse as it does in forward.

When a traction lever is pulled rearward, the rod connected to the lever positions the swash plate in the transmission piston pump to provide oil flow from the transmission (port B for the RH side or D for the LH side). This oil flows to the wheel motor and turns the motor in the reverse direction. Oil flow from the wheel motor returns to the transmission (port A or C) and is continuously pumped as long as the traction lever is pushed rearward.

As the traction load increases, reverse traction circuit pressure can increase to the relief valve setting of 4000 PSI (276 bar). If pressure exceeds the relief setting, oil flows through the reverse relief valve in the transmission to the low pressure side of the closed loop traction circuit.

The charge circuit functions the same in reverse as it does in the forward direction. The check valve placed in the reverse side of the traction circuit includes an orifice which allows the traction neutral position to be easier to adjust. The flushing valve remains seated during reverse operation.


Groundsmaster 7200/7210
Lift Circuit (Raise)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CYLINDER (EXTENDING)
Standard Deck lift (Summer mode) (RAISE POSITION)
OIL COOLER
Port 2
PRESSURE VALVE TEST PORT
Line Filter Beta II =200 (ISO 16889)
GEAR PUMP 6 cc/rev
IMPLEMENT RELIEF 3000PSI
Suction Screen 100 mesh
Port 1
CHARGE PRESSURE TEST PORT
PRESSURE VALVE 313±30 psi
43 psi
CHARGE PUMP 6cc/rev
CHARGE RELIEF 86±15 psi
ACCUMULATOR
2250 rpm
PTO CLUTCH
PTO pressure test port
18cc/rev
RELIEF VALVES 4000 PSI (276 bar)
FLUSHING VALVE
PORT A
PORT B
PORT C
PORT D
3/4 - 16 UNF
FORWARD
BYPASS VALVE
REAR PORT
FRONT PORT
RH WHEEL MOTOR 300 to 310 cc LSHT
LH WHEEL MOTOR 300 to 310 cc LSHT
3200 engine rpm

Lift Circuit (Raise)

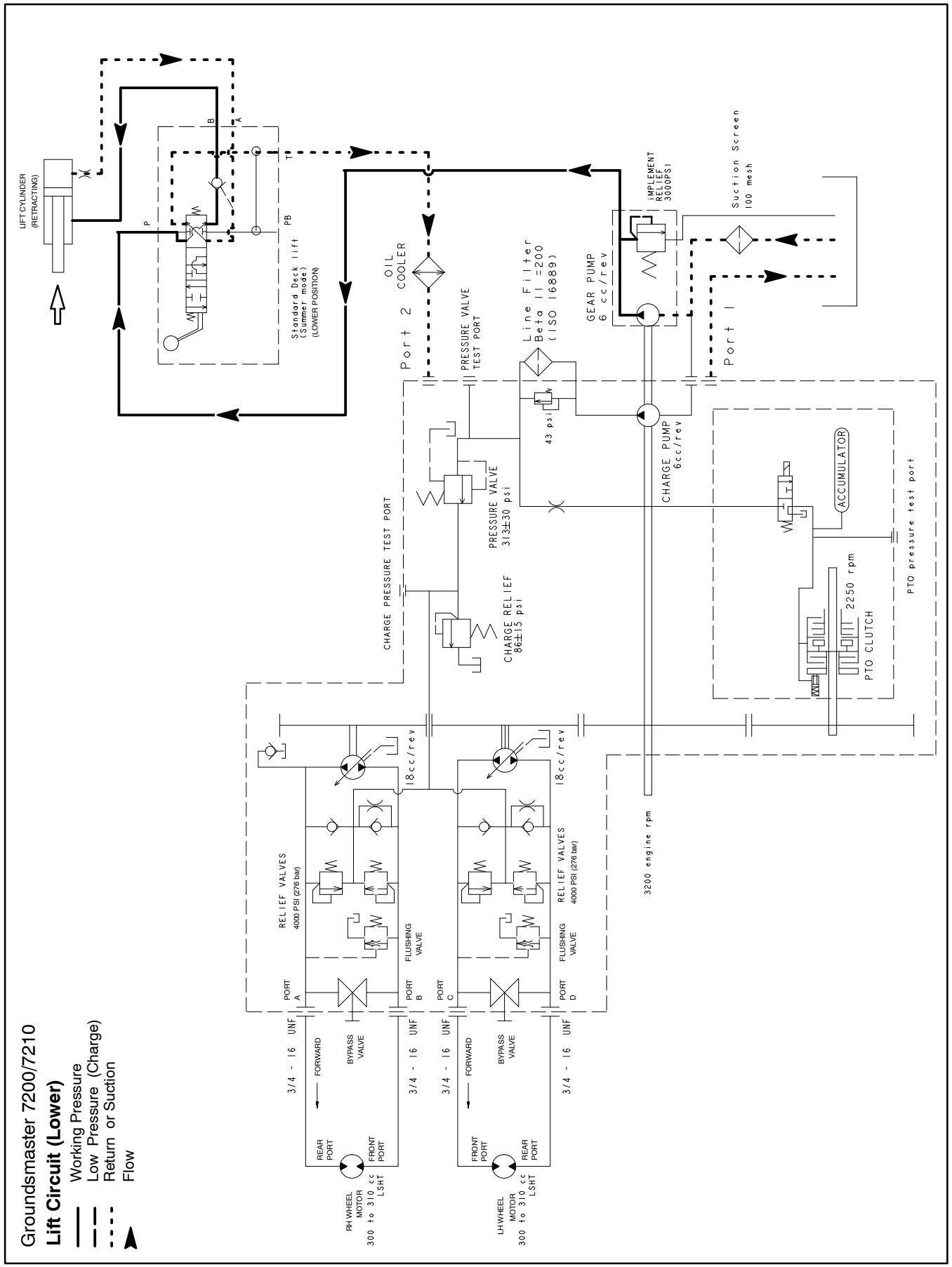
A single section gear pump is directly coupled to the transmission which is driven by the engine. This gear pump supplies hydraulic flow for raising and lowering the cutting deck (or implement). The pump takes its suction from the hydraulic tank.

During conditions of not raising or lowering the cutting deck (or implement), flow from the gear pump is bypassed by the lift control valve directly to the oil cooler and then to the transmission. Flow then returns to the hydraulic tank.

When the lift control lever is moved to the RAISE position, the control valve spool is shifted. This shifted spool allows hydraulic flow from the gear pump to the barrel end of the lift cylinder. At the same time, the pilot check valve in the lift control valve is unseated. The lift cylinder extends, causing the cutting deck (or implement) to raise. The fluid displaced from the rod end of the lift cylinder is routed past the unseated pilot check valve, to the oil cooler, transmission and then to the hydraulic tank. An orifice fitting at the barrel end of the lift cylinder controls the extending speed of the lift cylinder while raising the cutting deck (or implement).

Load on the lift cylinder causes lift circuit pressure to increase. If lift circuit pressure reaches implement relief valve pressure (3000 PSI/207 bar), the relief valve in the gear pump shifts to allow pump flow to return to the hydraulic tank. This condition occurs in both the raise and lower modes.

When the lift control lever is released from RAISE, spring action returns the control valve spool to its original, centered position, stopping lift cylinder movement. Gear pump flow is again bypassed through the oil cooler, transmission and to the hydraulic tank. The pilot check valve in the control valve will be reseated to lock the lift cylinder in place.


Groundsmaster 7200/7210
Lift Circuit (Lower)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CYLINDER (RETRACTING)
Standard Deck lift (Summer mode) (LOWER POSITION)
OIL COOLER
Port 2
PRESSURE VALVE TEST PORT
Line Filter Beta 11 =200 (ISO 16889)
GEAR PUMP 6 cc/rev
IMPLEMENT RELIEF 3000PSI
Suction Screen 100 mesh
Port 1
CHARGE PUMP 6cc/rev
43 psi
PRESSURE VALVE 313±30 psi
CHARGE PRESSURE TEST PORT
CHARGE RELIEF 86±15 psi
ACCUMULATOR
PTO pressure test port
2250 rpm
PTO CLUTCH
18cc/rev
18cc/rev
RELIEF VALVES 4000 PSI (276 bar)
RELIEF VALVES 4000 PSI (276 bar)
FLUSHING VALVE
FLUSHING VALVE
PORT A
PORT B
PORT C
PORT D
3/4 - 16 UNF
3/4 - 16 UNF
3/4 - 16 UNF
3/4 - 16 UNF
FORWARD
BYPASS VALVE
FORWARD
BYPASS VALVE
REAR PORT
FRONT PORT
FRONT PORT
REAR PORT
RH WHEEL MOTOR 300 to 310 cc LSHT
LH WHEEL MOTOR 300 to 310 cc LSHT
3200 engine rpm

Lift Circuit (Lower)

A single section gear pump is directly coupled to the transmission which is driven by the engine. This gear pump supplies hydraulic flow for raising and lowering the cutting deck (or implement). The pump takes its suction from the hydraulic tank.

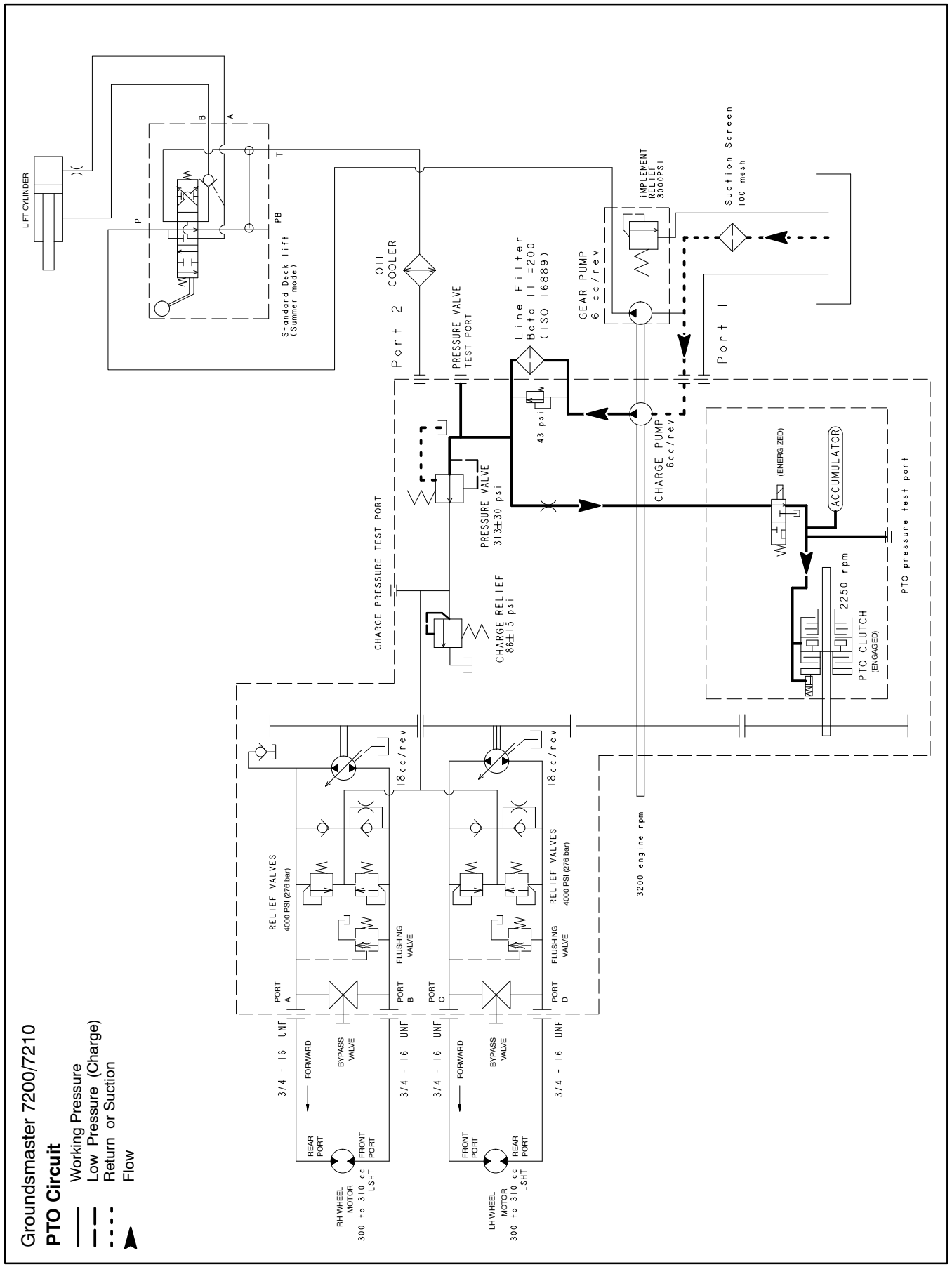
Circuit operation for lowering the cutting deck (or implement) is similar to raising it. However, hydraulic flow is used to contract the lift cylinder and this action allows the cutting deck (or implement) to lower.

During conditions of not raising or lowering the cutting deck (or implement), flow from the gear pump is by–passed by the lift control valve directly to the oil cooler and transmission. Flow then returns to the hydraulic tank.

When the cutting deck (or implement) is to be lowered, the lift control valve spool is shifted by moving the lift control lever to LOWER. This shifted spool allows gear pump flow to unseat the pilot check valve in the lift control valve and then to the barrel end of the lift cylinder. The lift cylinder contracts, causing the cutting deck (or implement) to lower. The fluid displaced from the barrel end of the lift cylinder is routed to the oil cooler, transmission and hydraulic tank. An orifice fitting at the barrel end of the lift cylinder controls the contracting speed of the lift cylinder while lowering the cutting deck (or implement).

Load on the lift cylinder causes lift circuit pressure to increase. If lift circuit pressure reaches implement relief valve pressure (3000 PSI/207 bar), the relief valve in the gear pump shifts allowing pump flow to return to the hydraulic tank. This condition occurs in both the raise and lower modes.

When the lift control lever is released from LOWER, spring action returns the spool to its original, centered position, stopping lift cylinder movement. Gear pump flow is again bypassed through the oil cooler, transmission and to the hydraulic tank. The pilot check valve in the control valve will be reseated to lock the lift cylinder in place.


Groundsmaster 7200/7210
PTO Circuit
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CYLINDER
Standard Deck lift (Summer mode)
OIL COOLER
Port 2
PRESSURE VALVE TEST PORT
Line Filter Beta 1 1 =200 (ISO 16889)
GEAR PUMP 6 cc/rev
IMPLEMENT RELIEF 3000PSI
Suction Screen 100 mesh
Port 1
CHARGE PUMP 6cc/rev
43 psi
PRESSURE VALVE 313±30 psi
CHARGE PRESSURE TEST PORT
CHARGE RELIEF 86±15 psi
(ENERGIZED)
ACCUMULATOR
PTO pressure test port
2250 rpm
PTO CLUTCH
(ENGAGED)
3200 engine rpm
18cc/rev
RELIEF VALVES 4000 PSI (276 bar)
FLUSHING VALVE
PORT A
PORT B
PORT C
PORT D
3/4 - 16 UNF
FORWARD
BYPASS VALVE
REAR PORT
FRONT PORT
RH WHEEL MOTOR 300 to 310 cc LSHT
LH WHEEL MOTOR 300 to 310 cc LSHT

PTO Circuit

The transmission used on Groundsmaster 7200 and 7210 machines includes a hydraulic, multi–plate clutch that is used to engage the PTO. Hydraulic flow for PTO clutch engagement is provided by the transmission charge pump.

When the PTO switch is turned on, the transmission solenoid valve is energized to allow hydraulic flow to engage the PTO clutch. As the PTO clutch engages, an integral PTO brake is simultaneously released to allow rotation of the drive shaft and cutting deck (or implement). An orifice and accumulator in the transmission prevent abrupt engagement of the PTO.

Pressure to the PTO clutch is limited by the pressure valve in the transmission. Pressure valve setting is from 280 to 340 PSI (19.3 to 23.4 bar).

When the PTO switch is turned off, the transmission solenoid valve is de–energized and the PTO clutch is disengaged. The integral PTO brake is applied to control the stopping rate of the drive shaft and cutting deck (or implement).

Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local tool supplier.

Hydraulic Pressure Test Kit

Toro Part Number: **TOR47009**

Use to take various pressure readings for diagnostic tests. Quick disconnect fittings provided attach directly to mating fittings on machine test ports without tools. A high pressure hose is provided for remote readings. Test Kit contains one each: 1000 PSI (70 bar), 5000 PSI (350 bar) and 10000 PSI (700 bar) gauges. Use gauges as recommended in the Testing Section of this chapter.

Figure 9

Hydraulic Tester (Pressure and Flow)

Toro Part Number: **TOR214678**

This tester requires O–ring face seal (ORFS) adapter fittings for use on this machine. Use this tester as recommended in the Testing Section of this chapter.

1. INLET HOSE: Hose connected from the system circuit to the inlet side of the hydraulic tester.

2. LOAD VALVE: A simulated working load is created in the circuit by turning the valve to restrict flow.

3. LOW PRESSURE GAUGE: Low range gauge to provide accurate reading at low pressure: 0 to 1000 PSI (0 to 70 bar).

   A protector valve cuts out when pressure is about to exceed the normal range for the gauge. The cutout pressure is adjustable.

4. HIGH PRESSURE GAUGE: High range gauge which accommodates pressures beyond the capacity of the low pressure gauge: 0 to 5000 PSI (0 to 350 bar).

5. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated at 15 GPM.

6. OUTLET HOSE: A hose from the outlet side of the hydraulic tester connects to the hydraulic system circuit.

Figure 10

Hydraulic Test Fitting Kit

Toro Part Number: **TOR4079**

This kit includes a variety of O–ring Face Seal fittings to enable the connection of test gauges into the system.

The kit includes: tee's, unions, reducers, plugs, caps and male test fittings.

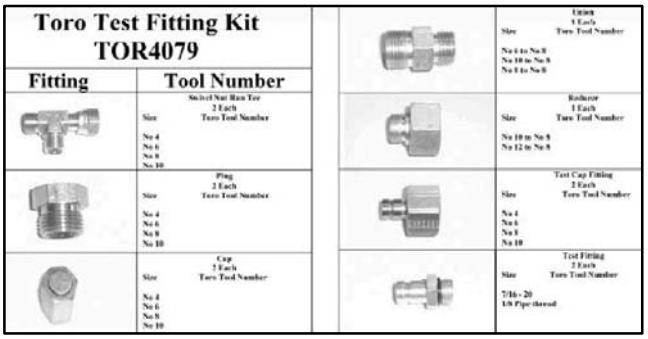


Figure 11

O–ring Kit

Toro Part Number: **16–3799**

This kit includes O–rings in a variety of sizes for face seal and port seal hydraulic connections. As a preventative measure against leakage, it is recommended that an O–ring be replaced any time a hydraulic connection is opened.

Figure 12

High Pressure Hydraulic Oil Filter

If a component failure occurs in the closed loop traction circuit, contamination from the failed part will remain in the circuit until removed. When connecting hydraulic test gauges in order to test traction circuit components or after replacing a failed traction circuit component (e.g. hydrostat or wheel motor), a high pressure hydraulic filter can be installed in the traction circuit. The filter will ensure that contaminates are removed from the closed loop and thus, do not cause additional component damage.

A high pressure hydraulic oil filter can be obtained locally.

Figure 13

Troubleshooting

The chart that follows contains information to assist in troubleshooting. There may possibly be more than one cause for a machine malfunction.

Refer to the Testing section of this Chapter for precautions and specific hydraulic test procedures.

Problem	Possible Cause
Hydraulic oil leaks from system.	Fitting(s), hose(s) or tube(s) are loose or damaged. O–ring(s) or seal(s) are missing or damaged.
Hydraulic fluid foams excessively causing oil leakage from hydraulic tank breather. **NOTE:** Some aeration of hydraulic oil on this machine is normal.	Oil level in hydraulic tank is low. Hydraulic system has wrong type of oil. One of the pump suction lines has an air leak. Incompatible hydraulic oils mixed in system. Water in hydraulic system.
Hydraulic system operates hot.	Transmission pressure is high due to load or dragging brakes. Oil level in hydraulic tank is low or inlet filter is loose or clogged. Oil is contaminated or oil viscosity is too light. Oil cooler is damaged or plugged. Oil cooler air flow is obstructed. Transmission by–pass valve(s) is open or defective. Gear pump relief valve is stuck open. Lift control valve is being held in the lift or lower position. Transmission check valve is not seating or is damaged. Charge pressure is low. Transmission or wheel motor(s) is worn or damaged. (NOTE: If one traction circuit component has internal wear or damage, it is possible that other traction components are also damaged)
Traction response is sluggish.	Transmission by–pass valve(s) is open or defective. Brake is dragging or binding. Transmission check valve, relief valve and/or flushing valve is leaking. Charge pressure is low. Hydraulic oil is very cold. Transmission or wheel motor(s) is worn or damaged. (NOTE: If one traction circuit component has internal wear or damage, it is possible that other traction components are also damaged)

Problem	Possible Cause
Neutral is difficult to find.	External control linkage is misadjusted, disconnected, binding or damaged. Orifice in transmission check valve(s) is plugged. Transmission is worn or damaged.
No traction exists in either direction.	Oil level in hydraulic tank is low. Transmission by–pass valves are open. Charge pressure is low. Engine flywheel coupling is damaged. Transmission or wheel motor(s) is worn or damaged. (NOTE: If one traction circuit component has internal wear or damage, it is possible that other traction components are also damaged)
Wheel motor will not turn.	Transmission by–pass valve(s) is open. Transmission or wheel motor is worn or damaged. (NOTE: If one traction circuit component has internal wear or damage, it is possible that other traction components are also damaged)
Wheel motor will not hold load in neutral. **NOTE:** Machine may not be completely stationary if parked on an incline without the parking brake engaged.	Make up fluid from charge pump is not available. Check valves in transmission are damaged. Valve plate(s) in transmission is worn or damaged. Wheel motor is worn or damaged. Cylinder block assembly in transmission is worn or damaged.
Single wheel motor turns while unloaded, but slows down or stops when load is applied.	Wheel motor is worn or damaged. Transmission components (e.g. piston pump, relief valve, check valve) for the problem wheel motor are worn or damaged. (NOTE: If one traction circuit component has internal wear or damage, it is possible that other traction components are also damaged)
Machine does not track straight. **NOTE:** If machine does not track straight, look for problem with components that effect the weaker traction side of the machine.	External traction control linkage is misadjusted, disconnected, binding or damaged. Transmission by–pass valve(s) is open. Brake is dragging or binding. Transmission check valve is not seating or is damaged. Transmission or wheel motor(s) is worn or damaged.

Problem	Possible Cause
Gear pump is noisy (cavitation).	Hydraulic tank oil level is low. Hydraulic oil is very cold. Suction line is restricted. Suction line has an air leak.
Cutting deck blades will not turn.	An electrical problem exists (see Chapter 5 – Electrical System). The engine coolant temperature is excessive. Transmission solenoid valve is stuck. Transmission charge pump is damaged (traction charge circuit also affected). Transmission pressure valve is faulty. Cutting deck problem exists (see Chapter 7 – Cutting Deck).
Cutting deck blade(s) turn too slowly.	Engine speed is too low. Cutting deck problem exists (see Chapter 7 – Cutting Deck).
PTO does not stop when disengaged.	An electrical problem exists (see Chapter 5 – Electrical System). Transmission solenoid valve is stuck or damaged. PTO brake friction plates are worn or damaged.
Cutting deck (or implement) will not lift or lifts slowly.	Engine speed is too low. Lift cylinder linkage is binding or broken. Lift arm bushings are binding. Hydraulic tank oil level is low. Gear pump pressure or flow is insufficient. Gear pump is damaged. Implement relief valve (in gear pump) is stuck open. Lift cylinder leaks internally. Lift control valve is defective.
Cutting deck (or implement) raises, but will not stay up. **NOTE:** Lift cylinder and check valve in lift control valve cannot provide an absolutely perfect seal. The cutting deck (or implement) may eventually lower if left in the raised position.	Lift cylinder leaks internally. Check valve within the lift control valve leaks. Lift control valve is worn or defective.

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Testing

The most effective method for isolating problems in the hydraulic system is by using hydraulic test equipment such as pressure gauges and flow meters in the circuits during various operational checks (see the Special Tools section in this Chapter).

Before Performing Hydraulic Tests

IMPORTANT: All obvious areas such as oil supply, oil filter, binding linkages, loose fasteners or improper adjustments must be checked before assuming that a hydraulic component is the source of the problem.

Precautions for Hydraulic Testing

CAUTION

Failure to use gauges with expected pressure (psi) rating as listed in test procedures could result in damage to the gauge and possible personal injury from leaking hot oil.

CAUTION

All testing should be performed by two (2) people. One person should be in the seat to operate the machine. The second person should monitor test equipment and record test results.

WARNING

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Do not use hands to search for leaks; use paper or cardboard. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

1. Clean machine thoroughly before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Contamination can cause excessive wear or binding of hydraulic components.

2. When conducting tests on the hydraulic system, wear eye protection.

3. Before testing, check traction control lever linkages for improper adjustment, binding or broken parts.

4. All hydraulic tests should be made with the hydraulic oil at normal operating temperature.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

5. Put clean metal caps or plugs on any hydraulic lines left open or exposed during testing or component removal.

6. When using hydraulic tester (pressure and flow), the inlet and the outlet hoses must be properly connected and not reversed to prevent damage to the hydraulic tester or components.

7. Install hydraulic fittings finger tight and far enough to make sure that they are not cross–threaded before tightening them with a wrench.

8. Position tester hoses to prevent rotating machine parts from contacting and damaging the hoses or tester.

9. After connecting test equipment, check oil level in the hydraulic tank to make sure that oil level is correct.

10. When using hydraulic tester (pressure and flow), open tester load valve completely before starting engine to minimize the possibility of damaging components.

11. The engine must be in good operating condition. Engine speed can affect the accuracy of the hydraulic tester readings. When performing hydraulic tests, check engine speed with a phototac.

12. If a traction circuit problem exists, consider performing one or more of the following tests: Charge Relief Valve Pressure, Transmission Piston Pump Flow, Traction Relief Valve Pressure and/or Wheel Motor Efficiency.

13. If a lift circuit problem exists, consider performing one or more of the following tests: Implement Relief Pressure, Gear Pump Flow and/or Lift Cylinder Internal Leakage.

14. If a PTO circuit problem exists, consider performing the PTO Pressure Valve Test.

Traction System Operation Testing

Because the Groundsmaster 7200/7210 traction system uses two (2) separate circuits, it can be difficult to identify which circuit is causing a problem and what hydraulic tests should be performed. Use the following operation tests and suggestions before performing the hydraulic tests described in this section.

1. If machine does not track in a straight line, look for a problem with components that affect the weaker traction side of the machine. During operation, the machine will steer toward the weaker side of the traction system. Because piston pump swash plate is controlled by traction control lever movement, if one lever rotates its swash plate more than the other lever, the machine will not track in a straight line.

2. Drive the machine up a moderate incline, stop the engine, place the traction control levers in the neutral locked position and allow the transmission to hold the machine in place (parking brake not applied). The machine should remain stationary on the incline or drift slowly backwards in a straight line. If one of the transmission traction circuits is faulty, the machine will roll backwards toward the weaker traction circuit.

3. Wheel speed should be the same on both rear wheels. Make sure hydraulic oil is at normal operating temperature. With machine jacked up off the ground and securely supported with jack stands, have an operator in the seat move the traction control levers to the full forward speed. Using a phototac, check the rotational speed of both rear wheels. The wheel speed should be from 190 to 200 RPM for both rear wheels.

4. If any of these operation tests suggest a traction system problem, check the following before performing hydraulic tests.

   A. Parking brake is dragging.

   B. Traction control lever is not adjusted correctly.

   C. Transmission bypass valve is not seated.

   D. Check oil level in the hydraulic tank to make sure that oil level is correct.

Charge Relief Valve Pressure Test (Using Pressure Gauge)

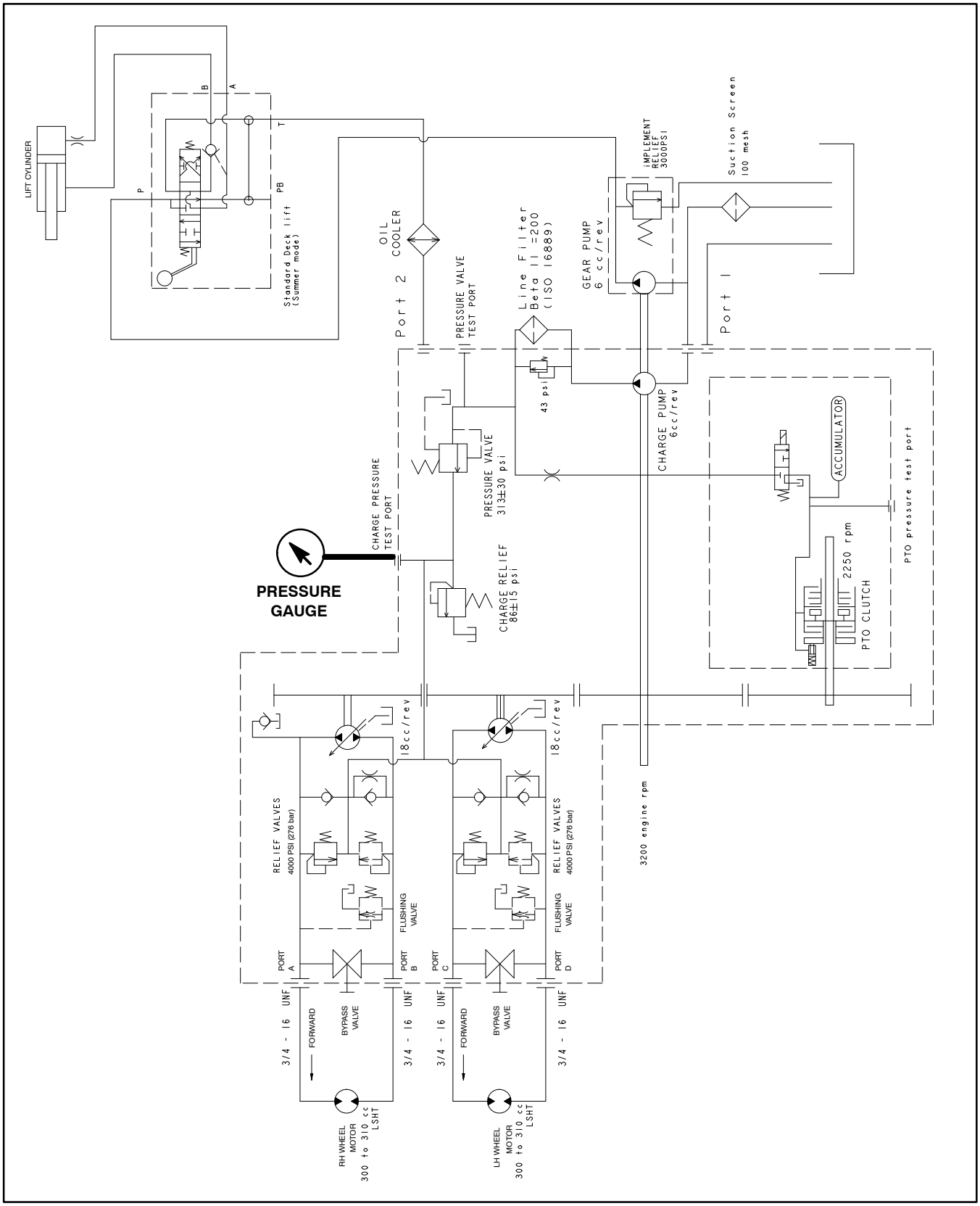

Figure 14

The Charge Relief Valve Pressure Test should be performed if a traction circuit problem is identified. This test will determine if the transmission charge relief valve is operating correctly.

Procedure for Charge Relief Valve Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature.

2. Make sure that traction drive is correctly adjusted for the neutral position.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

3. Park machine on a level surface with the cutting deck (or implement) lowered and off. Apply parking brake. Make sure engine is off.

4. Read Precautions for Hydraulic Testing listed at the beginning of this section.

5. Thoroughly clean transmission area surrounding charge pressure test port on right side of transmission (Fig. 15).

6. Remove plug from charge pressure test port (Fig. 15). Connect hydraulic pressure gauge (1000 PSI / 70 bar) with an attached hydraulic hose to the transmission charge pressure port.

7. Make sure that traction levers are in the neutral locked position and that the parking brake is applied.

8. Start engine and run at low idle speed **(1500 to 1650 RPM)**. Check for any hydraulic leakage from test connections and correct before proceeding with test.

9. With engine running, move throttle to full speed **(3200 RPM)**.

10. Pressure gauge should read from **70 to 100 PSI (4.8 to 6.9 bar)**. Record test result.

11. If charge relief pressure specification **is not** met, consider the following:

A. The transmission charge relief valve is faulty. Repair or replace the charge relief valve (see Transmission Service in the Service and Repairs section).

B. A transmission traction relief valve or flushing valve is leaking or damaged (see Transmission Service in the Service and Repairs section).

C. The charge pump in the transmission is faulty (PTO operation would also be affected. See Transmission Service in the Service and Repairs section).

12. A dynamic charge pressure test can be performed as follows:

A. With hydraulic pressure gauge still connected, sit in the operator seat and move the traction levers to forward.

B. While machine is moving, monitor the charge pressure reading on the pressure gauge.

C. The charge pressure should drop no more than 15% from initial test reading (Step 10 above) as the machine is moving (e.g. if initial charge pressure was 100 PSI (6.9 bar), charge pressure while machine is moving should be above 85 PSI (5.9 bar)).

D. A pressure drop of more than 15% indicates a traction circuit leak (e.g. a leaking transmission check valve, a worn/damaged transmission piston pump). If charge pressure is good under no load, but drops below specification when under traction load, the transmission piston pump(s) should be suspected of wear or damage. When a pump is worn or damaged, the charge pump is not able to keep up with internal leakage in the traction circuit.

13. Stop machine and shut off engine.

14. Relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section). Remove pressure gauge from transmission charge pressure test port. Install plug into port and torque plug from **13 to 15 ft–lb (17.7 to 21.5 N–m)**.

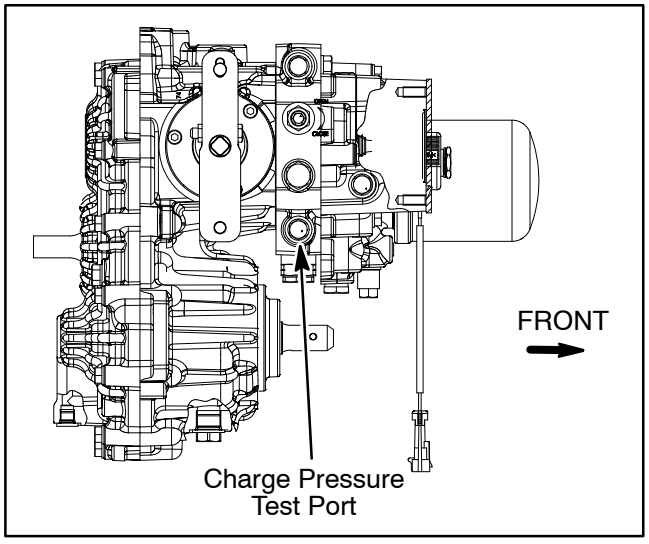

Figure 15

Transmission Piston Pump Flow Test (Using Tester with Pressure Gauges and Flow Meter)

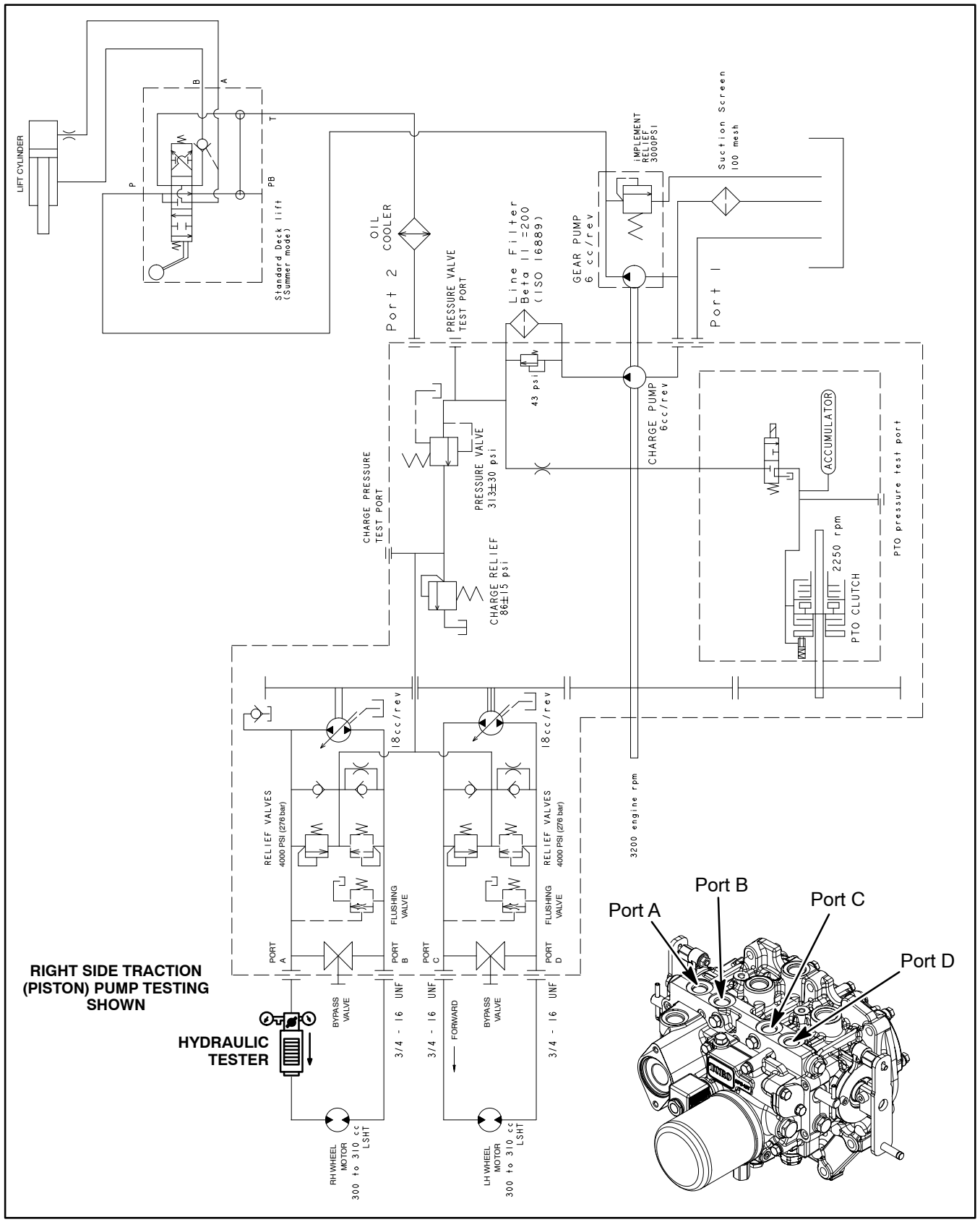

Figure 16

The Transmission Piston Pump Flow Test should be performed if a traction circuit problem is identified. This test will determine if hydraulic flow from a transmission piston pump is correct.

Procedure for Transmission Piston Pump Flow Test:

1. Make sure hydraulic oil is at normal operating temperature. Also, make sure that traction drive is correctly adjusted for the neutral position.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

2. Park machine on a level surface with the cutting deck (or implement) lowered and off. Make sure engine is off.

3. Read Precautions for Hydraulic Testing listed at the beginning of this section.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

4. Raise and support machine with jack stands so that both rear wheels are off the ground. In this test, the rear wheels need to spin freely to allow hydraulic flow through the traction circuit. Make sure that the parking brake is **not** applied.

5. Thoroughly clean transmission area surrounding traction circuit hoses on top of transmission (Fig. 16). Determine which piston pump is to be tested.

6. Disconnect hydraulic hose from transmission pump outlet fitting for piston pump to be tested (Fig. 16):

Piston Pump to be Tested	Pump Outlet
Right Side Pump	Port A
Left Side Pump	Port C

7. Install hydraulic tester (pressure and flow) in series between the pump outlet fitting and the disconnected hose. Make sure that the tester flow arrow points from the pump outlet and toward the hose. **Make sure the flow control valve on the tester is fully open.**

8. Sit in the operator seat, start engine and run at low idle speed **(1500 to 1650 RPM)**. Check for any hydraulic leakage from test connections and correct before proceeding with test.

IMPORTANT: Do not run engine at full speed when performing this flow test using Toro Hydraulic Tester (Pressure and Flow) (TOR214678). Traction pump output at full engine speed can damage hydraulic tester.

9. Using a phototac to measure engine speed, move throttle so engine speed is **2800 RPM (not full speed)**.

10. Have operator slowly push traction lever for pump being tested to fully **forward** position. Leave other traction lever in neutral position.

11. Slowly close tester flow control valve until pressure gauge reads **1000 PSI (69 bar)**. Verify with a phototac that the engine speed is still **2800 RPM**.

12. Observe flow gauge. TESTER READING should be approximately **13.3 GPM (50.3 LPM)** for a traction pump in good condition.

13. Open tester flow control valve, release traction lever to the neutral position and stop engine. Record test results.

14. Normal traction pump flow is **13.3 GPM (50.3 LPM)**. Lower pump flow would result in reduced traction circuit performance. If flow is less than **11 GPM (41.6 LPM)** or a pressure of **1000 PSI (69 bar)** cannot be obtained:

A. The traction control lever may need adjustment.

B. If the engine speed drops excessively as the tester flow control valve is closed, engine performance should be evaluated (see Chapter 3 – Kubota Diesel Engine).

C. If engine speed does not drop and pressure and flow specifications are not met, the tested transmission piston pump needs to be inspected, repaired or replaced as necessary.

15. If transmission piston pump flow specification **is** met, and a traction circuit problem has been identified, consider that a wheel motor is worn or damaged (see Wheel Motor Efficiency Test in this section).

16. Relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section). Disconnect tester from transmission fitting and hose. Reconnect hydraulic hose to transmission port fitting.

17. If necessary, repeat flow test for other transmission piston pump.

Traction Relief Valve Pressure Test (Using Tester with Pressure Gauges and Flow Meter)

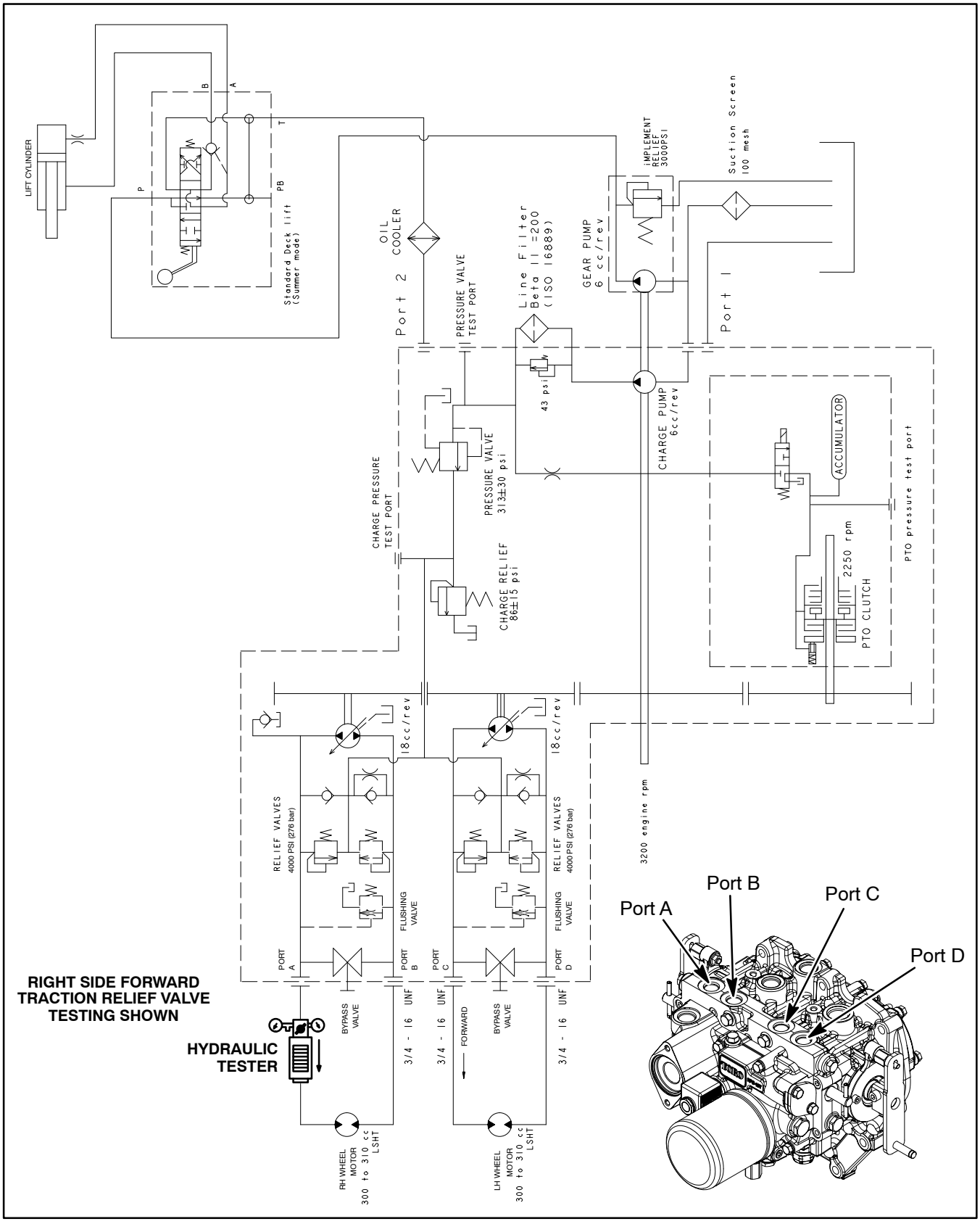

Figure 17

The Traction Relief Valve Pressure Test should be performed if a traction circuit problem is identified. This test will determine if a transmission relief valve is operating correctly.

Procedure for Traction Relief Valve Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature. Also, make sure that traction drive is correctly adjusted for the neutral position.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

2. Park machine on a level surface with the cutting deck (or implement) lowered and off. Make sure engine is off and that the parking brake is **not** applied.

3. Read Precautions for Hydraulic Testing listed at the beginning of this section.

4. Thoroughly clean transmission area surrounding traction circuit hoses on top of transmission (Fig. 17). Determine which traction relief valve is to be tested.

5. Disconnect hydraulic hose from transmission pump outlet fitting for relief valve to be tested (Fig. 17):

Relief Valve to be Tested	Pump Outlet
Right Side Forward	Port A
Right Side Reverse	Port B
Left Side Forward	Port C
Left Side Reverse	Port D

6. Install hydraulic tester (pressure and flow) in series with the pump outlet and the disconnected hose. Make sure that the tester flow arrow points from the pump outlet port and toward the hose for the relief valve direction that is to be tested. **Make sure the flow control valve on the tester is fully open.**

7. Start engine and run at low idle speed **(1500 to 1650 RPM)**. Check for any hydraulic leakage from test connections and correct before proceeding with test.

IMPORTANT: Do not run engine at full speed when performing this test using Toro Hydraulic Tester (Pressure and Flow) (TOR214678). Traction pump output at full engine speed can damage hydraulic tester.

8. Using a phototac to measure engine speed, move throttle so engine speed is **2800 RPM (not full speed)**.

9. Completely close flow control valve on tester.

10. Leave traction control lever for transmission pump **not** being tested in the neutral position.

11. While carefully monitoring tester pressure gauge, have operator slowly push traction lever for pump being tested (right side or left side) in direction being tested (forward or reverse) until pressure gauge stabilizes indicating that the relief valve has opened. Pressure gauge should read approximately **4000 PSI (276 bar)** as relief valve lifts.

12. Release traction lever to the neutral position, open tester flow control valve and stop engine. Record test results.

NOTE: The forward relief valves for the two (2) transmission pump circuits are identical and thus can be interchanged. The reverse relief valves are also identical. The forward relief valves, however, are different than the reverse relief valves so **do not** interchange forward and reverse relief valves.

13. If traction relief valve pressure **is not** met, remove and inspect relief valve from transmission (see Transmission Service in the Service and Repairs section of this chapter). Clean or replace relief valve. Relief valves are not adjustable.

14. Relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section). Disconnect tester from pump outlet fitting and hydraulic hose. Connect hose to pump fitting.

15. If necessary, repeat pressure test for other traction relief valves.

Wheel Motor Efficiency Test (Using Tester with Pressure Gauges and Flow Meter)

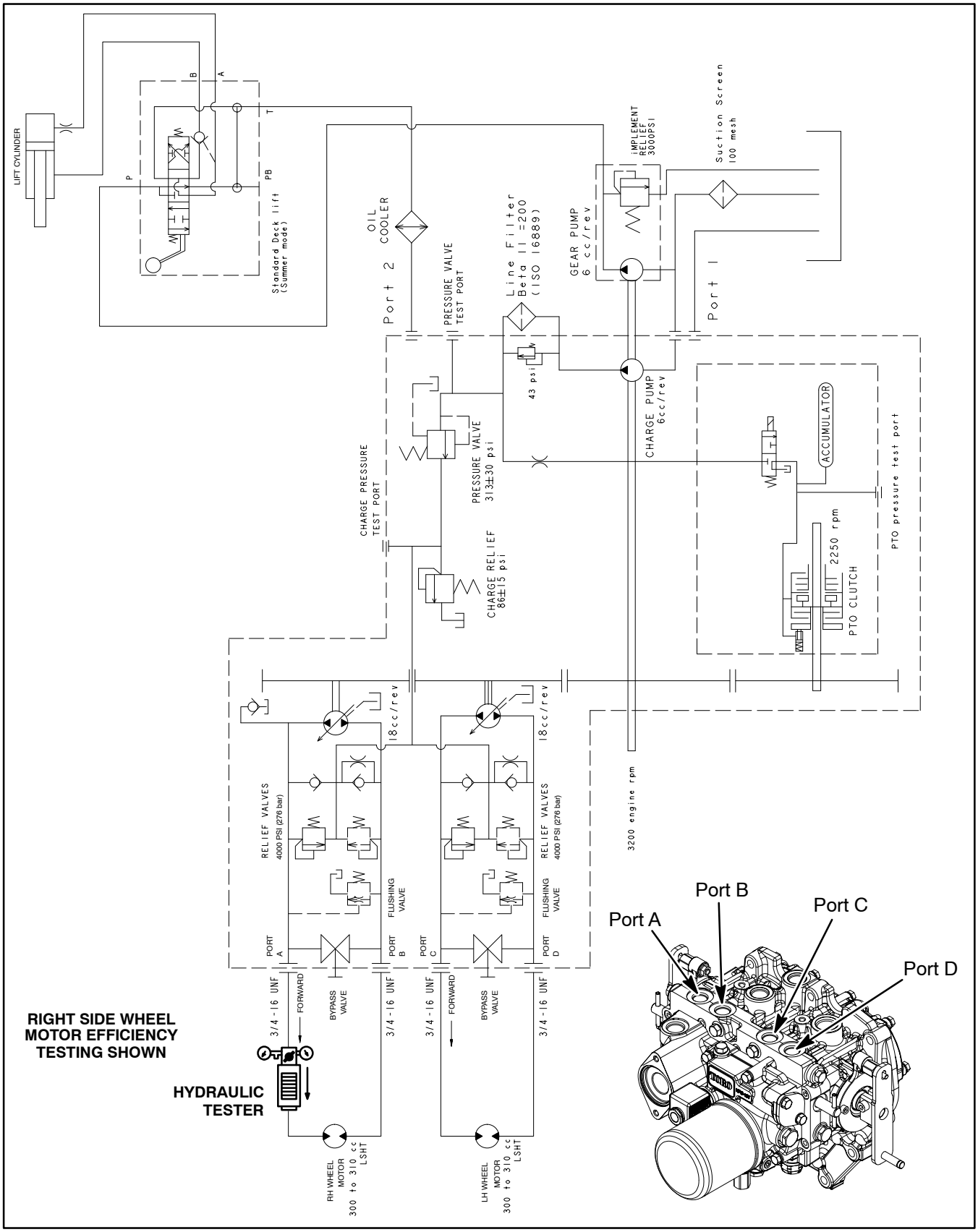

Figure 18

The Wheel Motor Efficiency Test should be performed if a traction circuit problem is identified. This test will determine if a wheel motor has excessive internal leakage and wear.

NOTE: Over a period of time, a wheel motor can wear internally. A worn motor may by–pass oil to its case drain causing the motor to be less efficient. Eventually, enough oil loss will cause the wheel motor to stall under heavy load conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system and affect overall machine performance.

Procedure for Wheel Motor Efficiency Test:

1. Make sure hydraulic oil is at normal operating temperature. Also, make sure that traction drive is correctly adjusted for the neutral position.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

2. Park machine on a level surface with the cutting deck (or implement) lowered and off. Apply parking brake and make sure engine is off.

3. Read Precautions for Hydraulic Testing listed at the beginning of this section.

4. Attach a heavy chain to the rear of the machine frame and an immovable object to prevent the machine from moving during testing. As an alternative, machine can be raised and supported with jack stands so that both rear wheels are off the ground.

5. Disconnect wire harness connector from parking brake switch (see Parking Brake Switch in the Components section of Chapter 5 – Electrical System). Install jumper wire across harness connector terminals to allow traction circuit operation with the parking brake applied.

6. Thoroughly clean transmission area surrounding traction circuit hoses on top of transmission (Fig. 18). Determine which wheel motor is to be tested.

7. Disconnect hydraulic hose from transmission pump outlet fitting for wheel motor to be tested (Fig. 18):

Wheel Motor to be Tested	Pump Outlet
Right Side Motor	Port A
Left Side Motor	Port C

8. Install hydraulic tester (pressure and flow) in series between the pump outlet fitting and the disconnected hose. Make sure that the tester flow arrow points from the pump outlet and toward the hose. **Make sure the flow control valve on the tester is fully open.**

9. Start engine and run at low idle speed **(1500 to 1650 RPM)**. Check for any hydraulic leakage from test connections and correct before proceeding with test.

IMPORTANT: Do not run engine at full speed when performing this test using Toro Hydraulic Tester (Pressure and Flow) (TOR214678). Traction pump output at full engine speed can damage hydraulic tester.

10. Using a phototac to measure engine speed, move throttle so engine speed is **2800 RPM (not full speed)**. Make sure parking brake is applied to keep wheel from rotating during test.

CAUTION

Use extreme caution when performing test. The rear wheel that is being tested will be trying to move the machine forward.

11. While sitting in operator seat, slowly push traction control lever for wheel motor being tested in the **forward** direction until **1000 PSI (69 bar)** is displayed on the tester pressure gauge.

12. Wheel motor internal leakage will be shown on the tester flow meter in GPM (LPM).

13. Return traction control lever to the neutral position. Shut off engine and record test results. Rotate wheel and retest. Testing of wheel motor leakage in three (3) different wheel positions will provide the most accurate test results.

14. Flow should be **less than 1.5 GPM (5.7 LPM)** for the tested wheel motor. If specification **is not** met, the tested wheel motor needs to be repaired or replaced.

15. Relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section). Disconnect tester from pump outlet fitting and hydraulic hose. Connect hose to pump fitting.

16. If other wheel motor requires testing, complete steps 6 to 15 for the remaining motor.

17. After testing is completed, remove jumper wire from parking brake harness connector. Connect wire harness to parking brake switch (see Parking Brake Switch in the Components section of Chapter 5 – Electrical System). Make sure that brake switch operation is correct.

PTO Pressure Valve Test (Using Pressure Gauge)

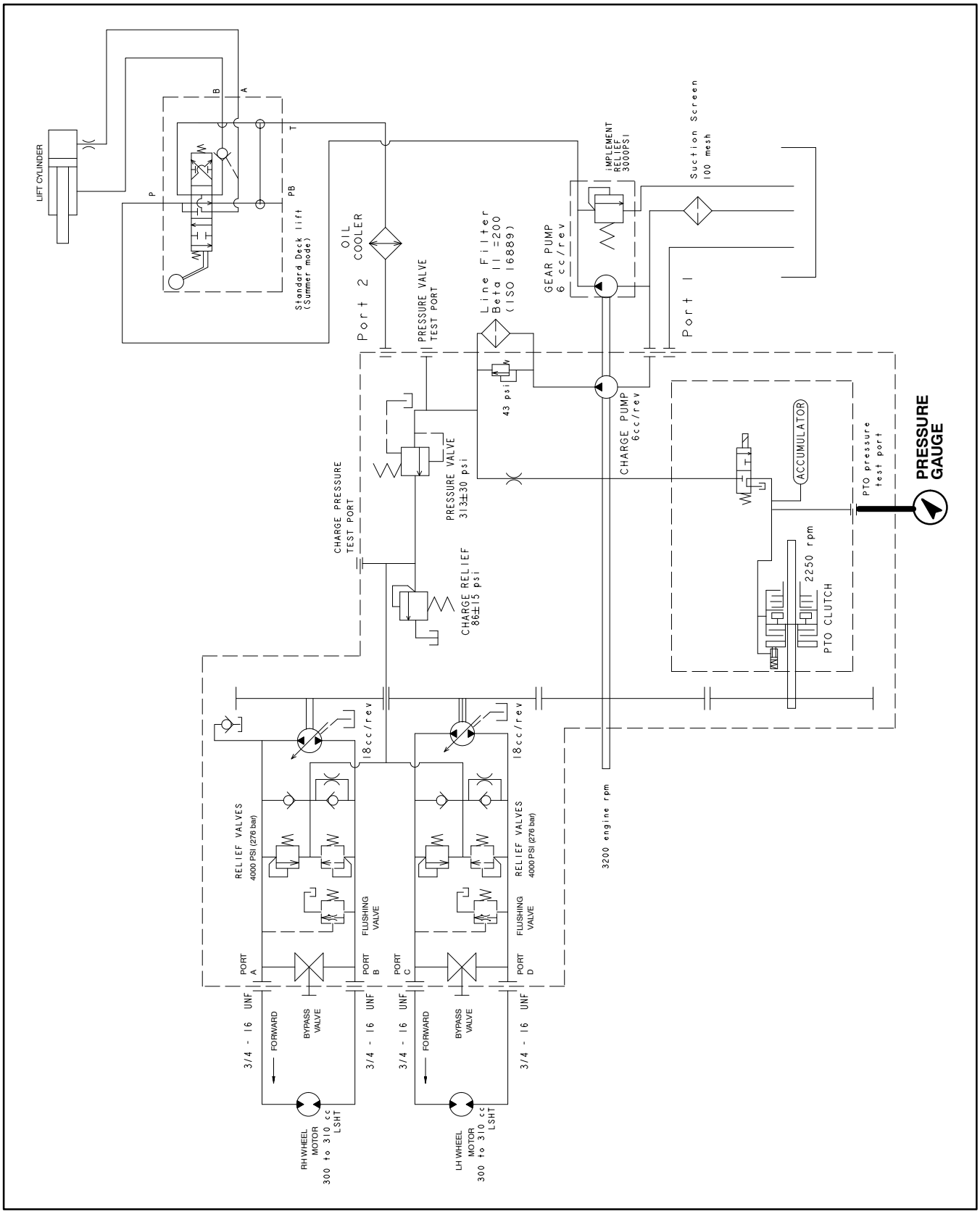

Figure 19

The PTO Pressure Valve Test should be performed if a PTO engagement problem is identified. This test will determine if the PTO pressure valve in the transmission is operating correctly.

Procedure for PTO Pressure Valve Test:

1. Make sure hydraulic oil is at normal operating temperature.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

2. Park machine on a level surface with the cutting deck (or implement) lowered and off. Make sure engine is off and the parking brake is applied.

3. Read Precautions for Hydraulic Testing listed at the beginning of this section.

4. Thoroughly clean transmission area surrounding pressure valve test port (Fig. 20).

5. Remove plug from pressure valve test port (Fig. 20). Connect hydraulic pressure gauge (1000 PSI / 70 bar) with an attached hydraulic hose to the test port.

6. Start engine and run at low idle speed **(1500 to 1650 RPM)**. Check for any hydraulic leakage from test connections and correct before proceeding with test.

7. With engine running, move throttle to full speed **(3200 RPM)**.

CAUTION

Keep away from deck (or implement) during test to prevent personal injury.

8. Have operator engage PTO and monitor the pressure gauge.

9. With the engine running at full speed and PTO engaged, pressure should be from **280 to 340 PSI (19.3 to 23.4 bar)**.

10. Disengage PTO and then stop engine. Record test results.

11. If specification **is not** met, repair or replace pressure valve in transmission (see Transmission Service in the Service and Repairs section of this chapter). Also consider a worn or damaged charge pump in the transmission (traction charge circuit would be affected as well).

12. Relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section). Disconnect test gauge from pressure valve test port. Install plug into port and torque plug from **14 to 15 ft–lb (18 to 21 N–m)**.

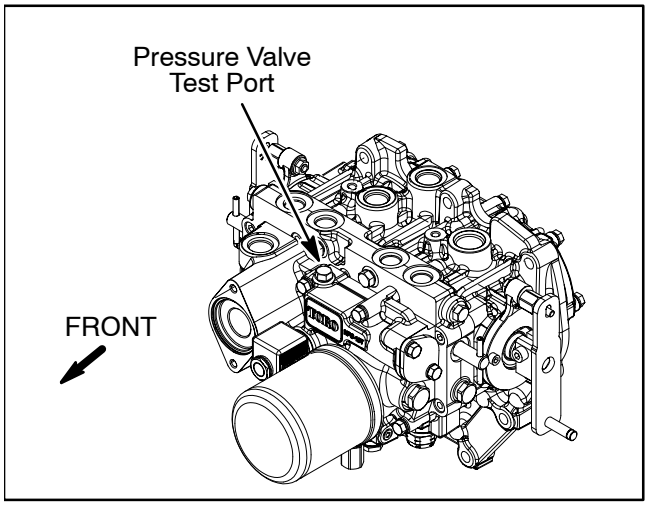

Figure 20

Implement Relief Pressure Test (Using Pressure Gauge)

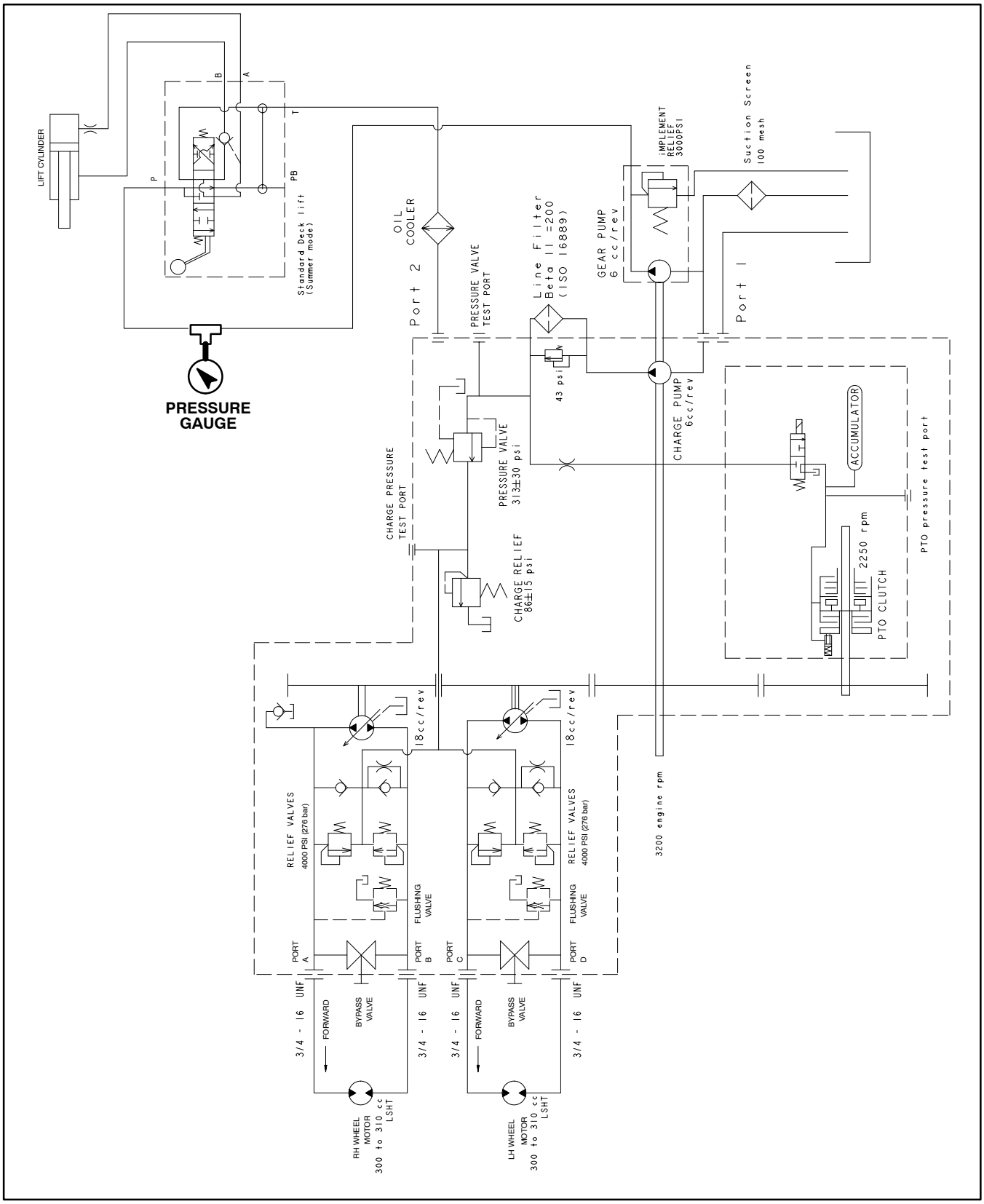

Figure 21

The Implement Relief Pressure Test should be performed if a cutting deck (or implement) raise and lower problem is identified. This test will determine if the implement relief valve is operating correctly.

Procedure for Implement Relief Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature.

2. Make sure that traction drive is correctly adjusted for the neutral position.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

3. Park machine on a level surface with the cutting deck (or implement) lowered and off. Make sure engine is off and the parking brake is engaged.

4. Read Precautions for Hydraulic Testing listed at the beginning of this section.

5. Thoroughly clean junction of hydraulic hose and lower fitting on rear of lift control valve (Fig. 22).

6. Disconnect hydraulic hose from lower fitting on rear of lift control valve (Fig. 22). This hose is from the gear pump outlet and provides oil flow to the lift control valve (Fig. 23).

NOTE: Implement relief pressure can also be tested with hydraulic tester (pressure and flow). Connect tester in series with the lift control valve fitting and the disconnected hose. Use pressure gauges on hydraulic tester and follow procedure below.

7. Install T–connector with hydraulic pressure gauge (5000 PSI / 345 bar) in series with the lift control valve fitting and the disconnected hose.

8. Start engine and run at low idle speed **(1500 to 1650 RPM)**. Check for any hydraulic leakage from test connections and correct before proceeding with test.

9. With engine running, move throttle to full speed **(3200 RPM)**.

IMPORTANT: Hold lift lever in the raise position only long enough to get a system pressure reading. Holding the lift lever in the raise position for an extended period may damage the lift control valve.

10. Watch pressure gauge carefully while moving lift lever to the raise position and holding.

11. System pressure should be approximately **3000 PSI (207 bar)** as the implement relief valve lifts. Return lift lever to the neutral position.

12. Stop engine. Record test results.

13. If specification **is not** met, repair or replace implement relief valve in gear pump (see Gear Pump Service in the Service and Repairs section of this chapter). Also consider a leaking lift cylinder, a damaged lift control valve or a worn gear pump.

14. Relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section). Disconnect T–connector with test gauge from lift control valve fitting and hydraulic hose. Reconnect hydraulic hose to control valve fitting.

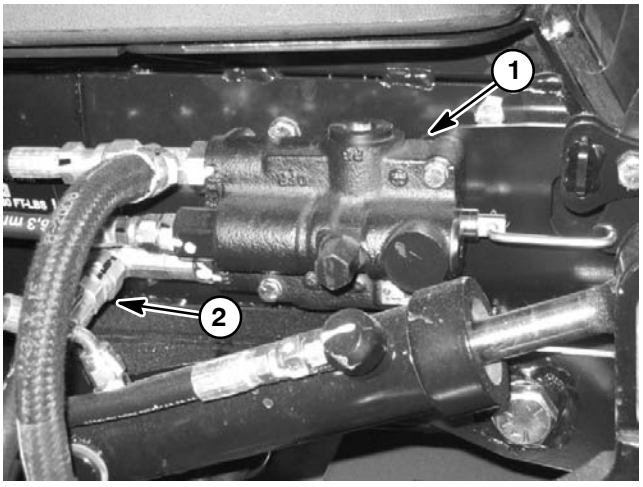

Figure 22

1. **Lift control valve**
2. **Hose from gear pump**

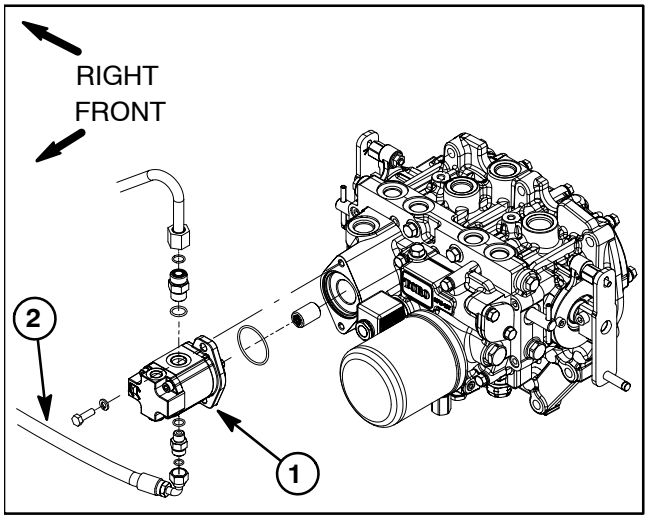

Figure 23

1. **Gear pump**
2. **Hose to lift control valve**

Gear Pump Flow Test (Using Tester with Pressure Gauges and Flow Meter)

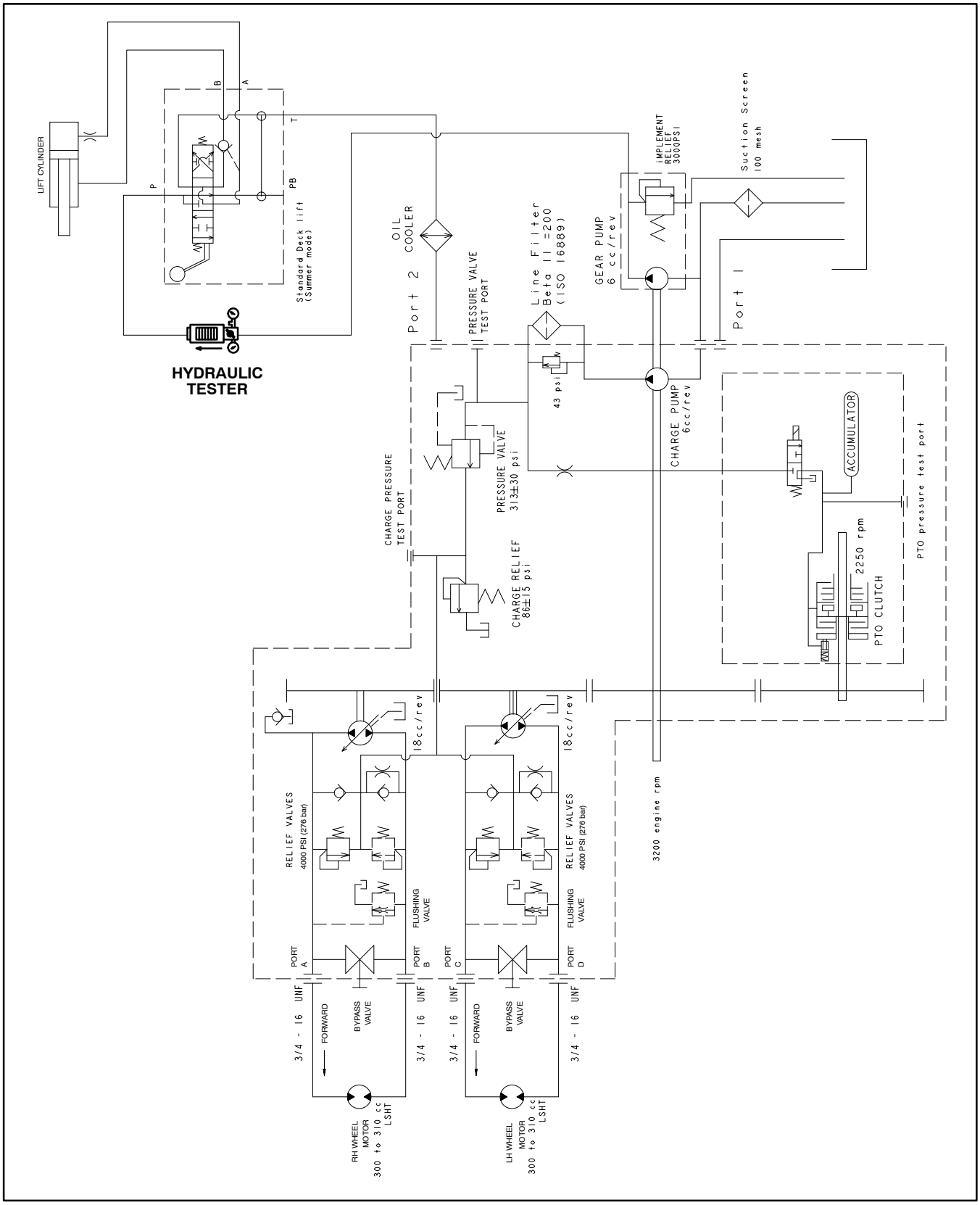

Figure 24

The Gear Pump Flow Test should be performed if a cutting deck (or implement) raise and lower problem is identified. This test will determine if hydraulic flow from the gear pump is correct.

Procedure for Gear Pump Flow Test:

NOTE: Over a period of time, the gears and wear plates in the gear pump can wear. A worn pump will by–pass oil and make the pump less efficient. Eventually, enough oil loss will occur to cause the cutting unit motors to stall under heavy cutting conditions. Continued operation with a worn, inefficient pump can generate excessive heat and cause damage to seals and other components in the hydraulic system.

1. Make sure hydraulic oil is at normal operating temperature.

2. Make sure that traction drive is correctly adjusted for the neutral position.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

3. Park machine on a level surface with the cutting deck lowered and off. Make sure engine is off and the parking brake is engaged.

4. Read Precautions for Hydraulic Testing listed at the beginning of this section.

5. Thoroughly clean junction of hydraulic hose and lower fitting on rear of lift control valve.

6. Disconnect hydraulic hose from lower fitting on rear of lift control valve (Fig. 25). This hose is from the gear pump outlet and provides oil flow to the lift control valve.

7. Install hydraulic tester (pressure and flow) in series with the gear pump fitting and the disconnected hose. Make sure that tester flow arrow points from the pump outlet port and toward the disconnected hose. **Make sure the flow control valve on the tester is fully open.**

8. Start engine and run at low idle speed **(1500 to 1650 RPM)**. Check for any hydraulic leakage from test connections and correct before proceeding with test.

9. With engine running, move throttle to full speed **(3200 RPM)**.

10. Watch tester pressure gauge carefully while slowly closing the flow control valve until **1000 PSI (69 bar)** is obtained. Do not close tester load valve fully. Verify with a phototac that the engine speed remains **3200 RPM** while maintaining **1000 PSI (69 bar)** on the tester pressure gauge.

11. Observe flow gauge. Flow indication for a pump in good condition is **5.4 GPM (20.4 LPM)**.

12. Open tester load valve and then stop engine. Record test results.

13. Normal pump flow is **5.4 GPM (20.4 LPM)**. Lower pump flow would result in reduced circuit performance. If flow was less than **4.8 GPM (18.2 LPM)** or a pressure of **1000 PSI (69 bar)** cannot be obtained, check for restriction in the pump inlet line. If inlet line is not restricted, remove gear pump and repair or replace as necessary.

NOTE: Implement relief valve pressure can also be tested with hydraulic tester (pressure and flow) in series with the gear pump fitting and the disconnected hose. Use pressure gauges on hydraulic tester and follow procedure for Implement Relief Pressure Test in this section.

14. Relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section). Disconnect tester from lift control valve fitting and hydraulic hose. Reconnect hose to the control valve fitting.

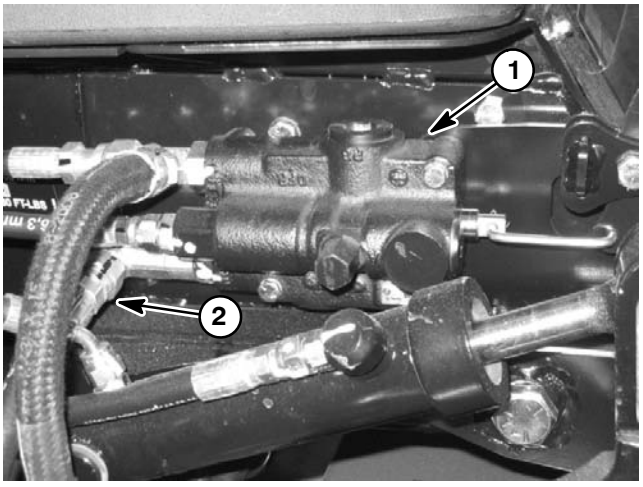

Figure 25

1. **Lift control valve**
2. **Hose from gear pump**

Lift Cylinder Internal Leakage Test

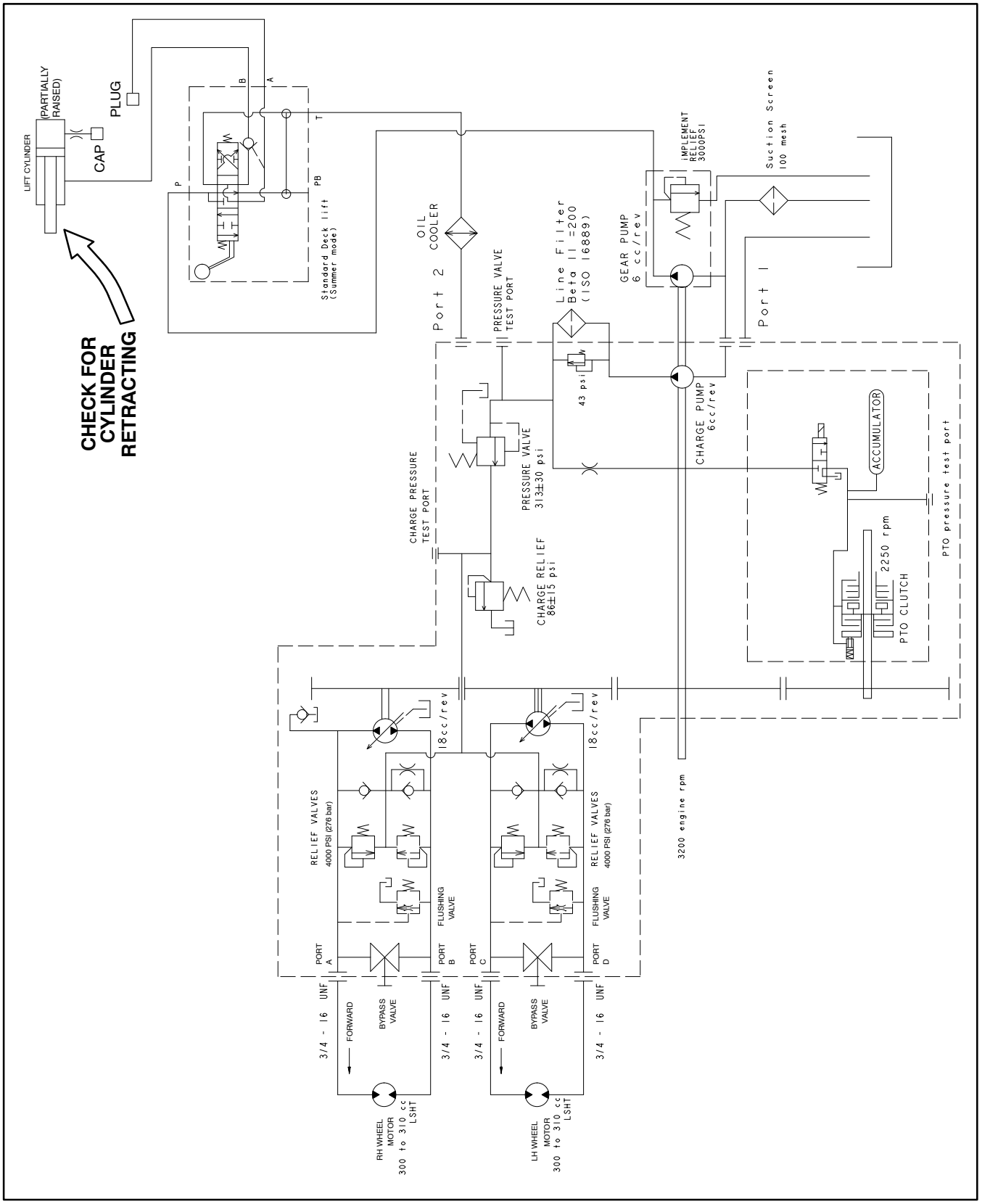

Figure 26

The Lift Cylinder Internal Leakage Test should be performed if a cutting deck (or implement) raise and lower problem is identified. This test will determine if the lift cylinder is faulty.

NOTE: Raise/lower circuit operation will be affected by lift cylinder binding, extra weight on the cutting deck (or implement) and/or binding of lift components. Make sure that these items are checked before proceeding with the lift cylinder internal leakage test.

Procedure for Lift Cylinder Internal Leakage Test:

1. Park machine on a level surface with the PTO switch OFF. Position the cutting deck (or implement) in a partially raised position and turn the engine off. Apply the parking brake.

2. Under both sides of the cutting deck (or implement), use a jack to raise the cutting deck (or implement) slightly. This will remove the load from the lift cylinder and relieve lift cylinder hydraulic pressure. Support both sides of the cutting deck (or implement) with jack stands to prevent the lift cylinder from retracting.

3. Thoroughly clean the area around the hydraulic hose end at the barrel end of the lift cylinder. Disconnect the hydraulic hose from the lift cylinder barrel end fitting (Fig. 27).

IMPORTANT: When capping the lift cylinder fitting and hydraulic hose end, use a steel cap and plug to ensure that fluid leakage will not occur. Plastic plugs will not hold hydraulic pressure that will be developed during this test procedure.

4. Place a steel cap on the open lift cylinder fitting to seal the lift cylinder. Also, install a steel plug in the open end of the disconnected hose to prevent leakage or contamination.

5. Remove the jack stands from under the cutting deck (or implement). The cutting deck (or implement) should settle slightly and then be supported by the capped lift cylinder.

6. Place a piece of tape on the lift cylinder rod near the rod end (Fig. 28). Measure and record the distance from the lift cylinder collar to the tape location.

7. Leave the machine parked for 4 hours and monitor the lift cylinder. The weight of the cutting deck (or implement) will cause the lift cylinder to gradually retract. Use the change in distance from the lift cylinder collar to the tape location to determine lift cylinder rod movement.

   A. If the cutting deck (or implement) is still suspended after 4 hours and lift cylinder rod movement is less than 1/4" (6.4 mm), consider that the lift cylinder is in good condition. A lift cylinder in good, usable condition will show minimal rod movement.

   B. Rod movement in excess of 1/4" (6.4 mm) after 4 hours indicates a lift cylinder with internal seal damage or excessive internal wear. Replace or repair the lift cylinder (see Lift Cylinder and Lift Cylinder Service in the Service and Repairs section of this chapter).

8. Once lift cylinder condition has been determined, use a jack to raise both sides of the cutting deck (or implement) slightly which will remove the load from the lift cylinder. Support both sides of the cutting deck (or implement) with jack stands. Remove the cap from the cylinder fitting and the plug from the hydraulic hose. Connect the hydraulic hose to the lift cylinder fitting.

9. Remove tape from lift cylinder rod.

10. Remove the jack stands from under the cutting deck (or implement). Start engine and operate lift cylinder through several raise and lower cycles. Stop the engine and check for any leakage.

11. Check oil level in hydraulic reservoir.

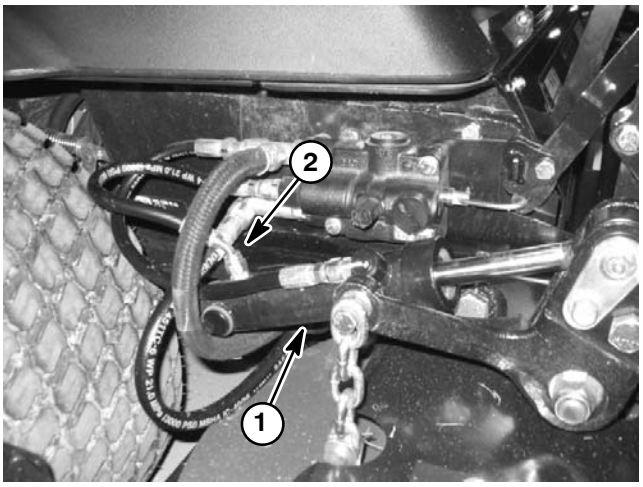

Figure 27

1. **Lift cylinder**
2. **Barrel end hose**

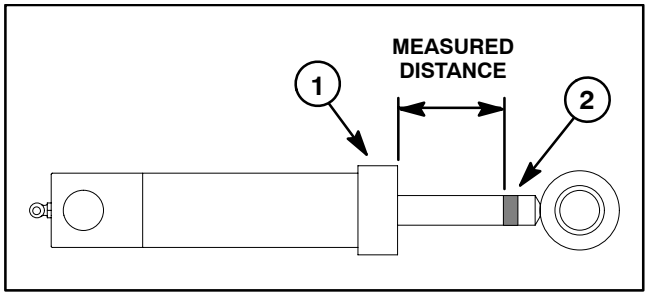

Figure 28

1. **Lift cylinder collar**
2. **Tape**

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General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Components

1. Before removing any parts from the hydraulic system, park machine on a level surface, engage parking brake, lower cutting deck (or implement) and stop engine. Remove key from the ignition switch.

2. Thoroughly clean machine before disconnecting, removing or disassembling any hydraulic components. Make sure hydraulic components, hoses, connections and fittings are cleaned thoroughly. Always keep in mind the need for cleanliness when working on hydraulic components.

3. Put labels on disconnected hydraulic lines and hoses for proper installation after repairs are completed.

4. Note the position of hydraulic fittings (especially elbow fittings) on hydraulic components before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hydraulic fittings, hoses and tubes.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

5. Hydraulic oil may be hot. Be careful when loosening and removing hydraulic system components.

6. Put clean caps or plugs on any hydraulic lines, hydraulic fittings and components left open or exposed to prevent contamination. Cap the opening as soon as line or port is exposed.

After Repair or Replacement of Components

1. Check oil level in the hydraulic tank and add correct oil if necessary. Use only hydraulic fluids specified in Operator's Manual. Drain and refill hydraulic tank and change oil filter if component failure was severe or system is contaminated (see Flush Hydraulic System in this section).

2. Lubricate O–rings and seals with clean hydraulic oil before installing hydraulic components.

3. Make sure caps or plugs are removed from the hydraulic tubes, hydraulic fittings and components before reconnecting.

4. Use proper tightening methods when installing hydraulic hoses and fittings (see General Information section).

5. After repairs, check control linkages or cables for proper adjustment, binding or broken parts.

6. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system (see Charge Hydraulic System in this section).

7. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in hydraulic tank and add correct oil if necessary.

Check Hydraulic Lines and Hoses

WARNING

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings, weather deterioration and chemical deterioration. Make any necessary repairs before operating equipment.

Flush Hydraulic System

IMPORTANT: Flush the hydraulic system any time there is a severe component failure or if the system is contaminated (oil appears milky, black or contains metal particles).

IMPORTANT: If a component failure occurred in the traction circuit, refer to Traction Circuit (Closed Loop) Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for at least four (4) hours.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

2. Park machine on a level surface. Lower cutting deck (or implement), stop engine and engage parking brake. Remove key from the ignition switch.

IMPORTANT: Make sure to thoroughly clean around all hydraulic connections that will be disassembled.

3. Drain hydraulic tank and transmission.

4. Drain hydraulic system. Drain all hoses, tubes and components while the system is warm.

5. Remove and replace hydraulic oil filter.

6. Inspect and clean hydraulic oil tank (see Hydraulic Tank Inspection in this section).

7. Reconnect all hydraulic hoses, lines and components that were disconnected to drain hydraulic system (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

IMPORTANT: Use only hydraulic fluids specified in Operator's Manual. Other fluids may cause system damage. Use of biodegradable hydraulic fluid in Groundsmaster 7200 and 7210 machines is not recommended.

8. Fill hydraulic tank with **new** hydraulic fluid.

9. Disconnect wire harness connector from engine fuel stop solenoid to prevent the engine from starting. Make sure traction levers and lift control lever are in the **neutral** position.

10. Turn ignition key switch to START and engage starter for **ten (10) seconds** to prime the transmission and gear pump. Repeat this step again.

11. Connect wire harness electrical connector to fuel stop solenoid.

12. Start engine and let it run at low idle speed **(1500 to 1650 RPM)** for a minimum of 2 minutes. Increase engine speed to high idle **(3200 to 3250 RPM)** for a minimum of 1 minute under no load.

13. Raise and lower cutting deck (or implement) several times.

14. Shut off engine and check for hydraulic oil leaks. Check oil level in hydraulic tank and add correct amount of oil if necessary.

15. Operate the machine for 2 hours under normal operating conditions.

16. Check condition of hydraulic oil. If the new fluid shows any signs of contamination, repeat steps 1 through 15 again until oil is clean.

17. Assume normal operation and follow recommended maintenance intervals.

Charge Hydraulic System

NOTE: When initially starting the hydraulic system with new or rebuilt components such as wheel motors, gear pump or lift cylinder, it is important that the hydraulic system be charged properly. Air must be purged from the system and its components to reduce the chance of damage.

IMPORTANT: Change hydraulic oil filter whenever hydraulic components are repaired or replaced.

1. Park machine on a level surface with engine off.

2. Make sure all hydraulic connections, lines and components are secured tightly.

3. If component failure was severe or the system is contaminated, flush and refill hydraulic system and tank (see Flush Hydraulic System in this section).

4. Make sure hydraulic tank is full. Add correct oil if necessary.

5. Check traction control components for proper adjustment, binding or damaged parts.

6. Disconnect wire harness connector from engine fuel stop solenoid to prevent the engine from starting.

7. Make sure traction control levers and the lift control lever are in the **neutral** position. Turn ignition key switch and engage starter for **ten (10) seconds** to prime the transmission and gear pump. Repeat this step again.

8. Connect wire harness connector to fuel stop solenoid.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

9. Raise both drive wheels off the ground and place jackstands under the frame to support the machine.

CAUTION

Make sure machine is safely supported so it will not move and accidentally fall to prevent injuring anyone under machine.

10. Make sure traction control levers and lift control lever are in the **neutral** position. Start engine and run at low idle speed **(1500 to 1650 RPM)**. The charge and gear pumps should pick up oil and fill the hydraulic system. If there is no indication of fill in 30 seconds, stop the engine and determine the cause.

11. After the hydraulic system starts to show signs of fill, actuate lift control lever until the lift cylinder moves in and out several times. If the lift cylinder does not move after 3 to 5 seconds or if the pump emits abnormal sounds, shut the engine off immediately and determine cause or problem. Inspect for the following:

    A. Loose oil filter or suction lines.

    B. Incorrect hose routing.

    C. Blocked suction line.

    D. Faulty implement relief valve.

    E. Faulty gear pump.

12. After lift cylinder moves normally, proceed to step 13.

13. Operate the traction control levers in the forward and reverse directions. The drive wheels should rotate in the proper direction. If the wheels rotate in the wrong direction, stop engine, inspect wheel motor location and hydraulic lines to wheel motors (see Transmission Installation in the Service and Repairs section of this chapter).

14. Adjust traction control levers to the neutral position (see Operator's Manual).

15. Lower machine to ground.

16. If the transmission or a wheel motor was replaced or rebuilt, operate the traction circuit on level ground so both drive wheels turn slowly for 10 minutes.

17. Operate machine by gradually increasing its work load to full over a 10 minute period.

18. Stop the machine. Check hydraulic oil level and adjust if necessary (do not overfill). Check hydraulic components for leaks. Tighten any loose connections.

Hydraulic Tank

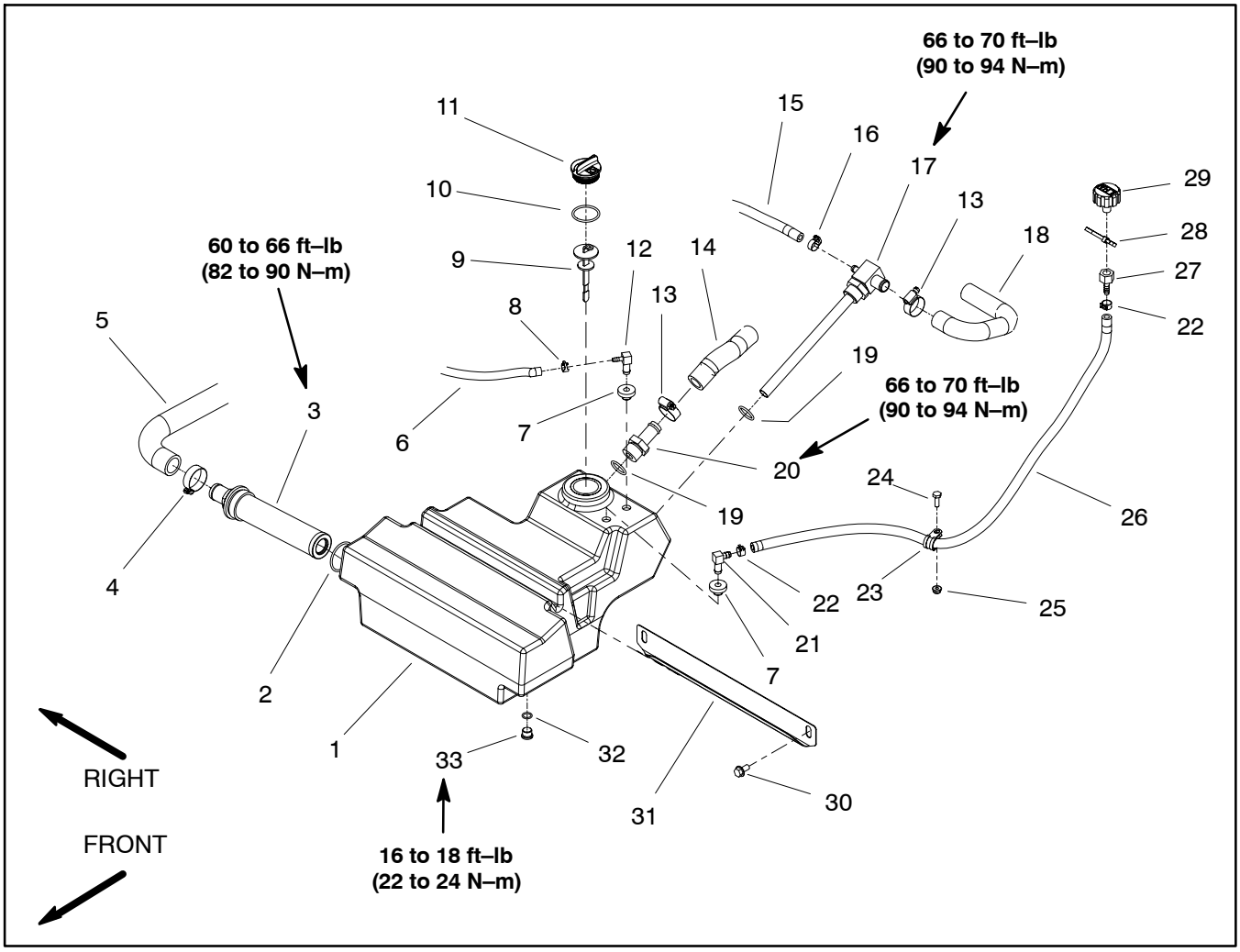

Figure 29

1. Hydraulic tank
2. O–ring
3. Strainer
4. Hose clamp
5. Hydraulic hose
6. Hydraulic hose
7. Grommet
8. Hose clamp
9. Dipstick
10. O–ring
11. Tank cap
12. Elbow fitting
13. Hose clamp
14. Hydraulic hose
15. Hydraulic hose
16. Hose clamp
17. Hydraulic T–fitting
18. Hydraulic hose
19. O–ring
20. Straight fitting
21. Elbow fitting
22. Hose clamp
23. R–clamp
24. Cap screw
25. Flange nut
26. Hydraulic hose
27. Straight fitting
28. Cable tie
29. Breather
30. Washer head screw (2 used)
31. Tank support
32. O–ring
33. Plug

Hydraulic Tank Removal (Fig. 29)

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Remove operator seat and seat base (see Operator Seat Removal in the Service and Repair section of Chapter 6 – Chassis).

3. Remove front cover from machine (Fig. 30).

4. Remove brake handle from machine to allow removal of hydraulic tank (see Parking Brake Assembly in the Service and Repairs section of Chapter 6 – Chassis).

5. Drain hydraulic oil from hydraulic tank.

6. Thoroughly clean hydraulic hose ends and fittings on hydraulic tank to prevent hydraulic system contamination.

7. Label all hydraulic hoses and fittings for assembly purposes. Remove hydraulic hoses from fittings on hydraulic tank. Drain hoses into a suitable container.

8. Put clean plugs in disconnected hydraulic hoses and fittings to prevent system contamination.

9. Remove two (2) washer head screws and tank support that retain hydraulic tank to frame.

10. Remove hydraulic tank toward front of machine.

11. Inspect foam strips under hydraulic tank. Replace strips if damaged.

12. As needed, remove fittings from hydraulic tank using Figure 29 as a guide. Discard and replace any removed O–rings.

Hydraulic Tank Inspection (Fig. 29)

1. Clean hydraulic tank and suction strainer with solvent.

2. Inspect hydraulic tank for leaks, cracks or other damage.

Hydraulic Tank Installation (Fig. 29)

1. If suction strainer was removed from hydraulic tank, place new, lubricated O–ring on strainer. Thread strainer into tank and torque from **60 to 66 ft–lb (82 to 90 N–m)**.

2. Attach removed fittings with new, lubricated O–rings to hydraulic tank using Figure 29 as a guide (see Hydraulic Fitting Installation in the General Information section of this chapter). Tighten fittings to torque values identified in Figure 29.

3. Position hydraulic tank to machine. Secure tank to frame with tank support and two (2) washer head screws.

4. Remove plugs that were installed to hydraulic hoses and fittings during the removal procedure.

5. Attach hydraulic hoses to fittings on hydraulic tank using labels placed during removal (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Install brake handle to machine (see Parking Brake Assembly in the Service and Repairs section of Chapter 6 – Chassis). Make sure that parking brake switch operation is correct after brake handle is installed.

7. Secure front cover to machine (Fig. 30).

8. Fill hydraulic tank with **new** hydraulic fluid.

9. Install operator seat and seat base (see Operator Seat Installation in the Service and Repair section of Chapter 6 – Chassis).

10. Operate machine. Check hydraulic oil level and adjust if necessary. Check hydraulic components for leaks. Tighten any loose connections.

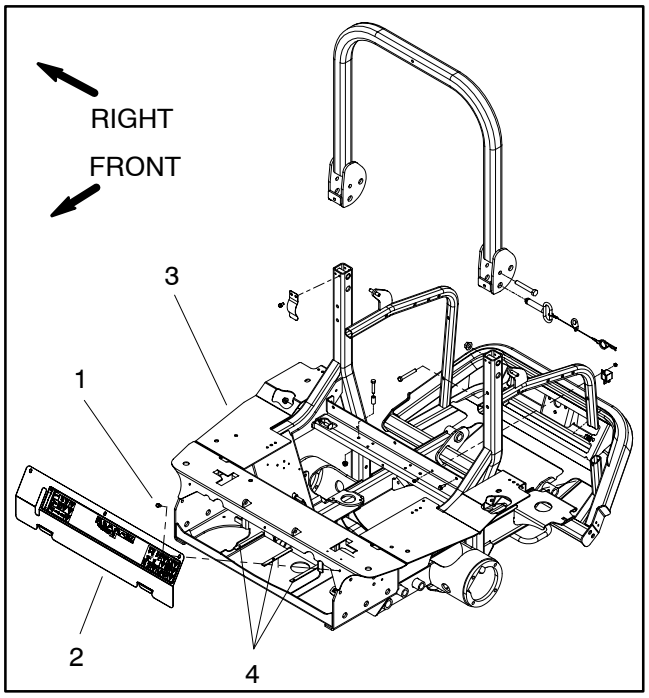

Figure 30

1. **Screw (3 used)**
2. **Front cover**
3. **Frame**
4. **Foam strip (3 used)**

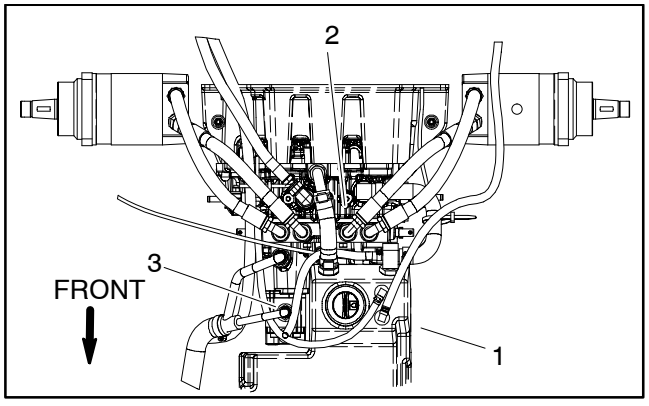

Figure 31

1. **Hydraulic tank**
2. **Transmission**
3. **Gear pump**

Wheel Motors

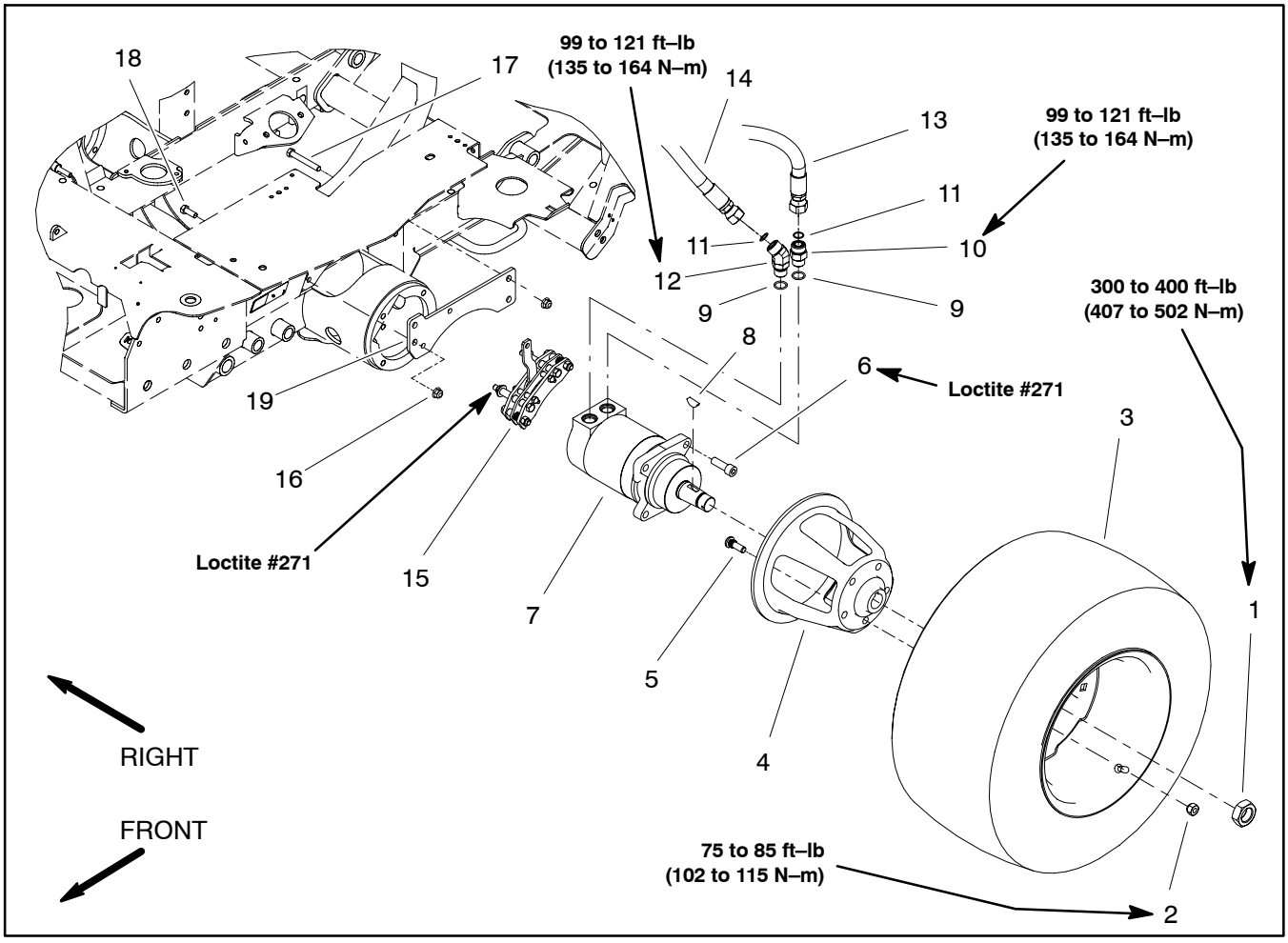

Figure 32

1. Lock nut
2. Lug nut (5 used per wheel)
3. Wheel assembly
4. Wheel hub
5. Wheel stud (5 used per wheel)
6. Socket head screw (4 used per motor)
7. Wheel motor (LH shown)
8. Woodruff key
9. O–ring
10. Hydraulic fitting
11. O–ring
12. Hydraulic fitting
13. Hydraulic hose
14. Hydraulic hose
15. Brake caliper (LH shown)
16. Flange nut (4 used per side)
17. Cap screw (2 used per side)
18. Cap screw (2 used per side)
19. Brake support

Removal (Fig. 32)

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Loosen but do not remove lock nut that secures wheel hub to wheel motor.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

3. Jack up machine enough to allow the removal of the drive wheel. Support machine with jack stands.

4. Remove wheel assembly and brake assembly from the machine (see Wheel Removal and Brake Removal in the Service and Repairs section of Chapter 6 – Chassis).

IMPORTANT: DO NOT hit wheel hub, wheel hub puller or wheel motor with a hammer during removal or installation. Hammering may cause damage to the wheel motor.

5. Use appropriate puller to loosen wheel hub from wheel motor.

6. Remove lock nut and loosened wheel hub from motor shaft. Locate and retrieve woodruff key from wheel motor shaft.

7. Thoroughly clean hydraulic hose ends and fittings on wheel motor to prevent hydraulic system contamination.

8. Label all hydraulic hoses and fittings for assembly purposes (Fig. 33). Remove hydraulic hoses from fittings on wheel motor. Allow hoses to drain into a suitable container.

9. Mark hydraulic fitting orientation to allow correct assembly. Remove hydraulic fittings from wheel motor. Remove and discard O–rings from fittings.

10. Put clean plugs in disconnected hydraulic hoses and wheel motor ports to prevent system contamination.

11. Support the wheel motor to prevent it from falling during removal.

12. Remove four (4) socket head screws that secure wheel motor to the machine.

13. Remove wheel motor from frame.

Installation (Fig. 32)

IMPORTANT: Because of internal differences in wheel motors, DO NOT interchange wheel motors on machine (i.e. do not put RH motor on left side of machine). If necessary, use parts catalog and part number on wheel motor to identify RH and LH motors.

1. Position wheel motor to frame. Make sure that ports in wheel motor are facing up.

2. Clean threads in frame and on socket head screws.

3. Apply Loctite #271 (or equivalent) to threads of socket head screws. Secure wheel motor to frame with four (4) socket head screws.

4. Remove plugs from disconnected hydraulic hoses and wheel motor ports.

5. Lubricate and install new O–rings to hydraulic fittings. Install fittings into wheel motor ports (see Hydraulic Fitting Installation in the General Information section of this chapter). Make sure that fittings are orientated correctly.

6. Using labels placed during the removal process, properly connect hydraulic hoses to wheel motor fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Make sure that tapers of wheel motor shaft and wheel hub are thoroughly clean.

8. Position woodruff key to keyslot in wheel motor shaft.

9. Place wheel hub on motor shaft and secure with lock nut.

10. Install brake assembly and wheel assembly to the machine. Make sure that proper clearance exists between brake assembly and wheel hub rotor (see Wheel Installation and Brake Installation in the Service and Repairs section of Chapter 6 – Chassis).

11. Lower the machine to the ground.

12. Torque lock nut (item 1) from **300 to 400 ft–lb (407 to 502 N–m)**.

13. Make sure hydraulic tank is full. Add correct oil if necessary.

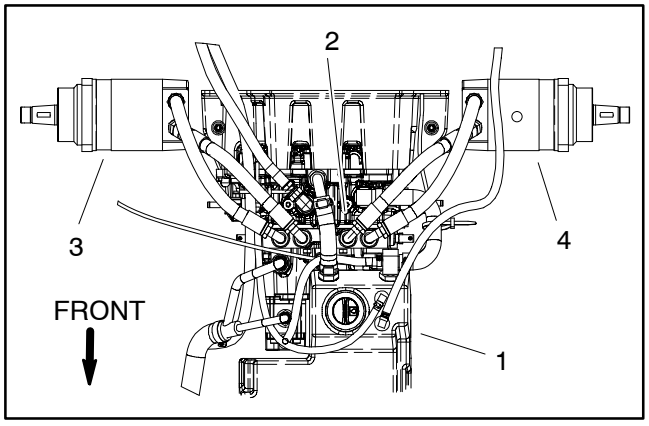

Figure 33

1. **Hydraulic tank**
2. **Transmission**
3. **RH wheel motor**
4. **LH wheel motor**

Wheel Motor Service

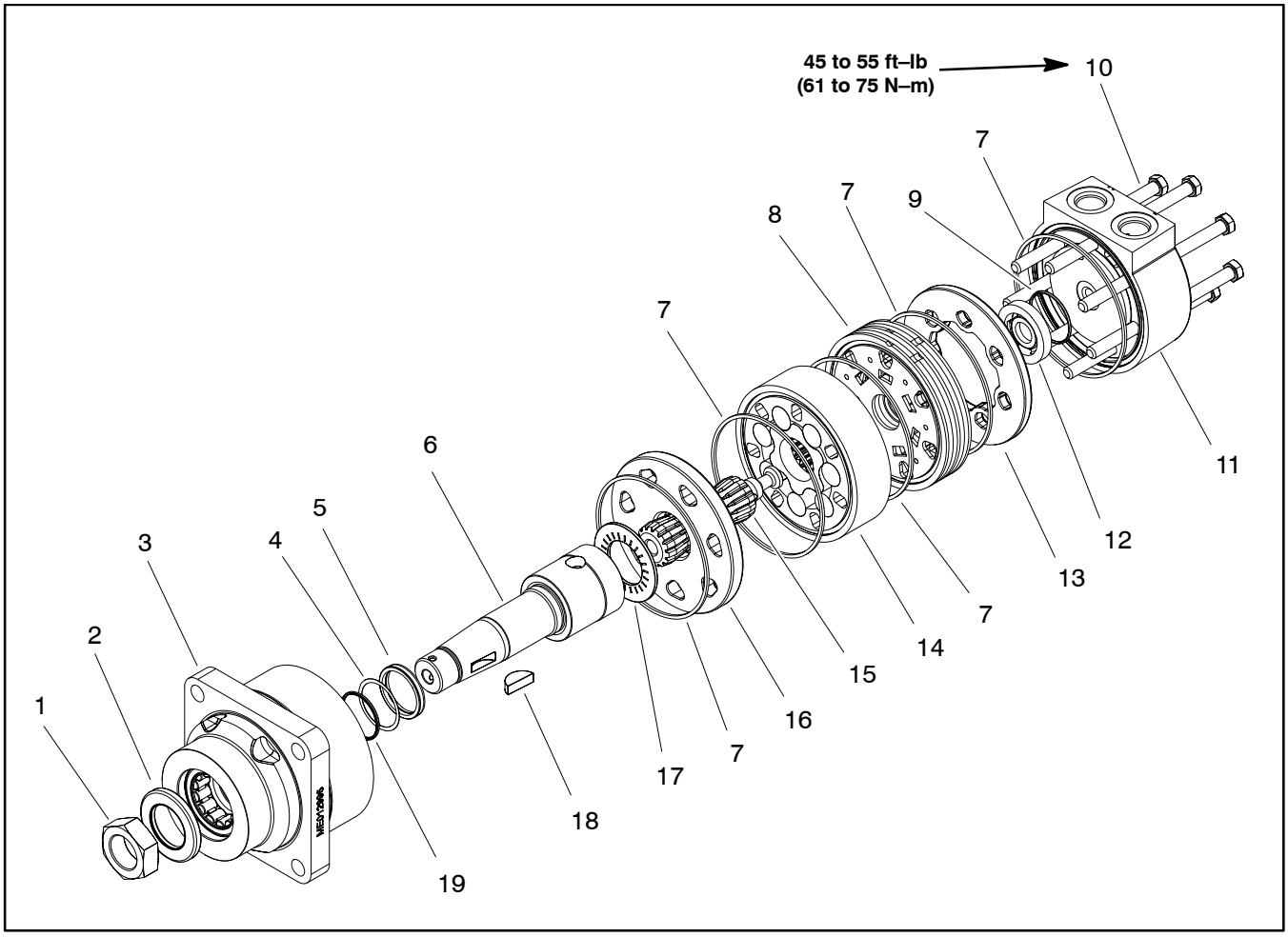

Figure 34

1. **Lock nut**
2. **Dirt/water seal**
3. **Housing**
4. **Back–up washer**
5. **Shaft seal**
6. **Coupling shaft**
7. **Body seal (5 used)**
8. **Manifold**
9. **Commutator ring**
10. **Cap screw (7 used)**
11. **End cover**
12. **Commutator**
13. **Commutator ring**
14. **Stator assembly**
15. **Drive link**
16. **Wear plate**
17. **Thrust bearing**
18. **Woodruff key**
19. **Back–up ring**

NOTE: The two wheel motors used on the Groundsmaster 7200/7210 have the same basic construction. The left wheel motor has a yellow sticker on the port side of the stator. The right wheel motor has a reverse timed manifold.

IMPORTANT: DO NOT interchange wheel motors on machine (i.e. do not put RH motor on left side of machine). If necessary, use parts catalog and part number on wheel motor to identify RH and LH motors.

NOTE: For wheel motor repair procedures, see the Parker Torqmotor™ Service Procedure (TC, TB, TE, TJ, TF, TG, TH and TL Series) at the end of this chapter.

IMPORTANT: If a wheel motor failure occurred, refer to Traction Circuit (Closed Loop) Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

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Transmission

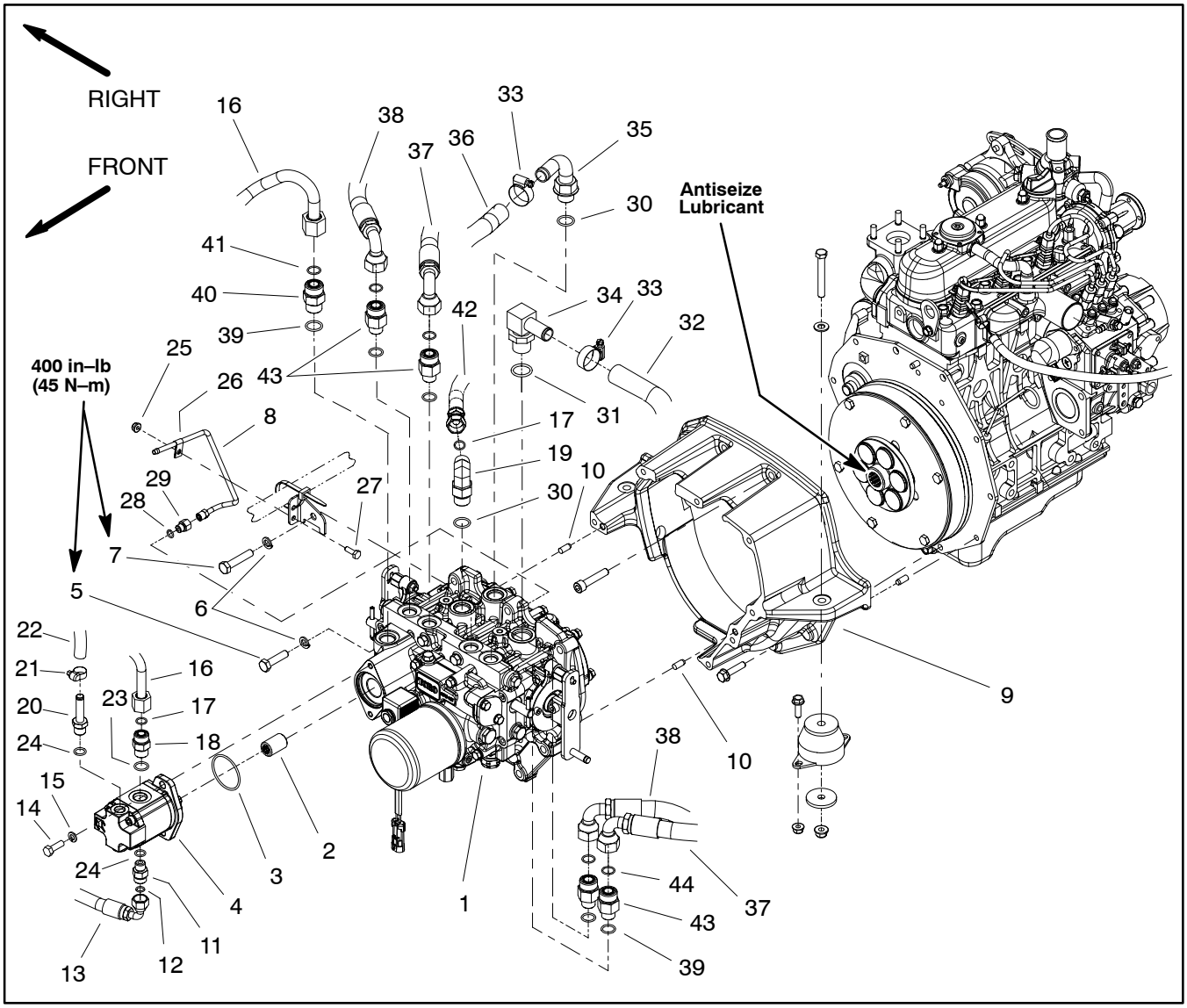

Figure 35

1. Transmission
2. Coupler
3. O–ring
4. Gear pump
5. Cap screw (40 mm long)
6. Lock washer (7 used)
7. Cap screw (50 mm long) (6 used)
8. Tube
9. Flywheel housing
10. Dowel pin (2 used)
11. Hydraulic fitting
12. O–ring
13. Hydraulic hose
14. Cap screw (2 used)
15. Lock washer (2 used)
16. Hydraulic tube
17. O–ring
18. Hydraulic fitting
19. 90º hydraulic fitting
20. Hydraulic fitting
21. Hose clamp
22. Hydraulic hose
23. O–ring
24. O–ring
25. Hex nut
26. Clip
27. Cap screw
28. O–ring
29. Hydraulic fitting
30. O–ring
31. O–ring
32. Hydraulic hose
33. Hose clamp
34. 90º hydraulic fitting
35. 90º hydraulic fitting
36. Hydraulic hose
37. Hydraulic hose (2 used)
38. Hydraulic hose (2 used)
39. O–ring
40. Hydraulic fitting
41. O–ring
42. Hydraulic hose
43. Hydraulic fitting (4 used)
44. O–ring

Transmission Removal (Fig. 35)

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Remove operator seat and seat base (see Operator Seat Removal in the Service and Repair section of Chapter 6 – Chassis).

3. On both sides of machine, remove cap screw and lock nut that secures the pump control rod to the traction control hub (Fig. 36). Note that cap screw is installed from the outside toward the center of the machine.

4. Unplug wire harness electrical connector from transmission solenoid valve coil. Position wire harness away from transmission.

5. Drain oil from hydraulic tank and transmission.

6. Thoroughly clean hydraulic hose ends and fittings on transmission, gear pump and hydraulic tank to prevent hydraulic system contamination.

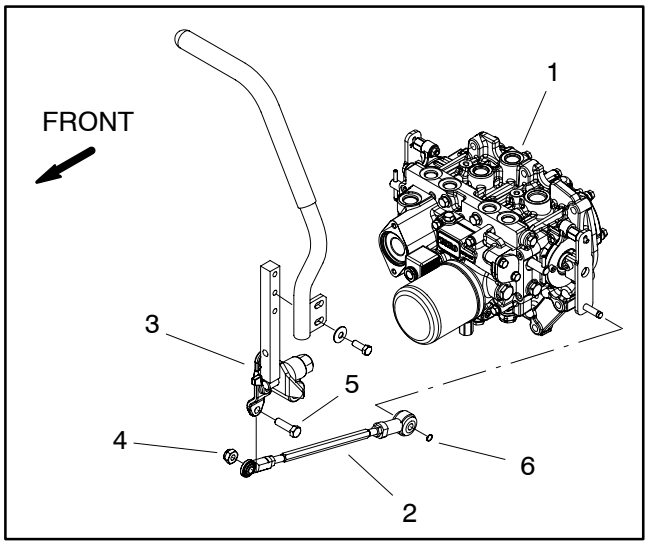

Figure 36

1. **Transmission**
2. **Pump control rod**
3. **Traction control hub**
4. **Lock nut**
5. **Cap screw**
6. **Retaining ring**

7. Label all hydraulic hoses and fittings for assembly purposes. Remove hydraulic hoses from fittings on transmission, gear pump and hydraulic tank. Allow hoses to drain into a suitable container.

8. Install clean plugs in hose and fitting openings to prevent system contamination.

9. Remove hydraulic tank (see Hydraulic Tank Removal in this section).

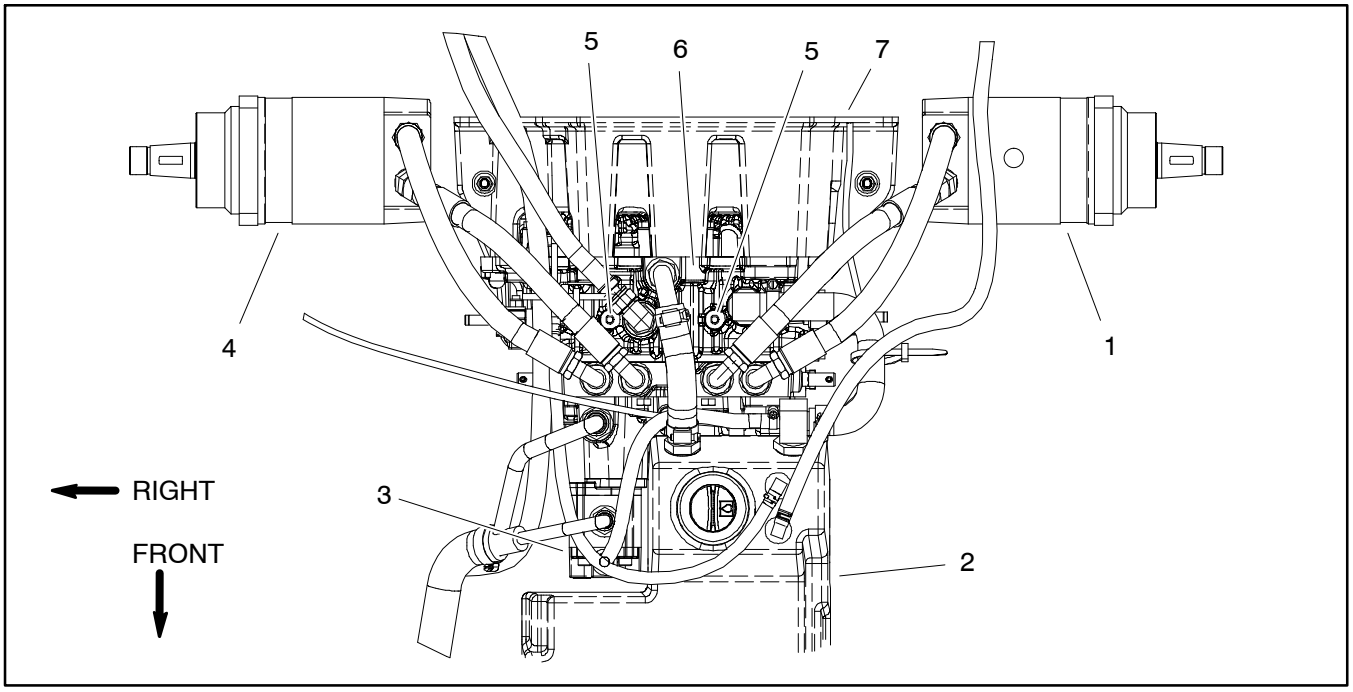

Figure 37

1. **LH wheel motor**
2. **Hydraulic tank**
3. **Gear pump**
4. **RH wheel motor**
5. **8mm threaded boss**
6. **Transmission**
7. **Flywheel housing**

10. Remove oil filter from transmission. Discard filter. If necessary, remove gear pump from transmission (see Gear Pump Removal in this section).

NOTE: Two (2) 8 mm eyebolts can be installed into threaded bosses in top of transmission to allow use of a lift or hoist to remove transmission (Fig. 37).

CAUTION

Support transmission assembly when removing it from the flywheel housing to prevent it from falling and causing personal injury.

11. Remove seven (7) cap screws and lock washers that secure the transmission to the flywheel housing. Note location of the shorter cap screw for assembly purposes.

IMPORTANT: Make sure to not damage the transmission, flywheel housing, hydraulic lines, electrical harness or other parts while removing transmission.

12. Move transmission assembly toward the front of the machine and away from the flywheel housing and coupler on engine flywheel. Lift transmission from machine.

13. Locate and note location of two (2) dowel pins from transmission and flywheel housing.

14. On both sides of transmission, remove retaining ring that secures pump control rod end onto transmission control arm (Fig. 36). Slide control rod from control arm.

15. If hydraulic fittings are to be removed from transmission, mark fitting orientation to allow correct assembly. Remove hydraulic fittings from transmission as needed. Discard fitting O–rings.

16. Inspect flywheel housing and coupler on engine flywheel for evidence of wear or damage.

Transmission Installation (Fig. 35)

1. Make sure that flywheel coupler and flywheel housing are secure on engine (see Engine Installation in the Service and Repairs section of Chapter 3 – Kubota Diesel Engine).

2. If hydraulic fittings were removed from transmission, lubricate and install new O–rings to fittings. Install fittings into transmission ports (see Hydraulic Fitting Installation in the General Information section of this chapter). Tighten fittings to torque values identified in Figure 38).

3. If gear pump was removed from transmission, install gear pump (see Gear Pump Installation in this section).

4. Slide both pump control rods onto transmission control arms and secure with retaining rings (Fig. 36).

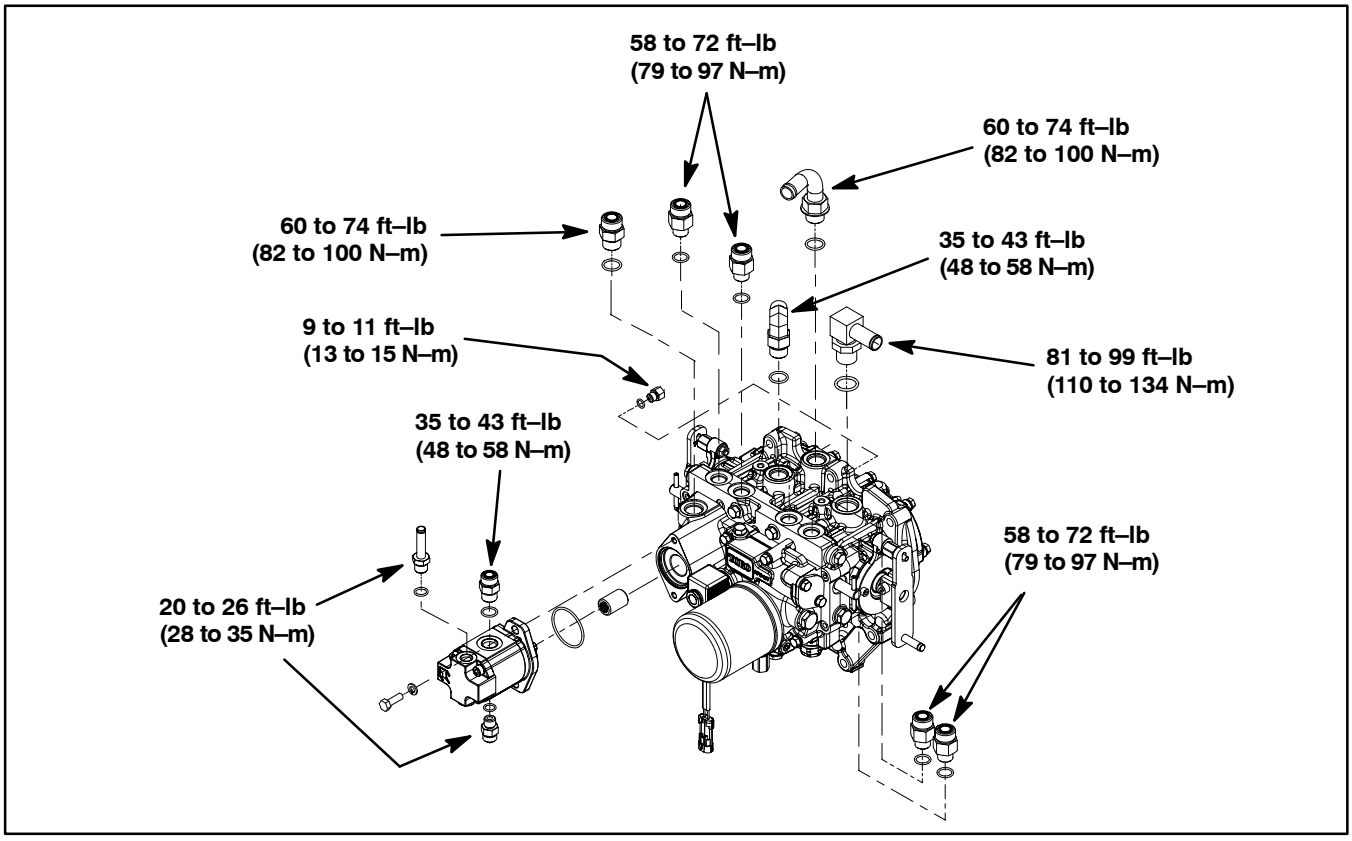
58 to 72 ft–lb
(79 to 97 N–m)
60 to 74 ft–lb
(82 to 100 N–m)
60 to 74 ft–lb
(82 to 100 N–m)
35 to 43 ft–lb
(48 to 58 N–m)
9 to 11 ft–lb
(13 to 15 N–m)
81 to 99 ft–lb
(110 to 134 N–m)
35 to 43 ft–lb
(48 to 58 N–m)
58 to 72 ft–lb
(79 to 97 N–m)
20 to 26 ft–lb
(28 to 35 N–m)

Figure 38

5. Apply a generous amount of antiseize lubricant to splines of transmission input shaft and flywheel coupler.

6. Place two (2) dowel pins in flywheel housing.

IMPORTANT: Make sure to not damage the transmission, flywheel housing, hydraulic lines, electrical harness or other parts while installing transmission.

CAUTION

Support transmission assembly when installing it to the flywheel housing to prevent it from falling and causing personal injury.

7. Lower transmission into machine. Align transmission input shaft with flywheel coupler and slide transmission to flywheel housing. Support transmission to prevent it from shifting.

8. Secure transmission to the flywheel housing with seven (7) cap screws and lock washers. Make sure that shorter cap screw is properly positioned. Torque cap screws **400 in–lb (45 N–m)**.

9. Install hydraulic tank to machine (see Hydraulic Tank Installation in this section).

10. On both sides of machine, secure the pump control rod to the traction control hub with cap screw and lock nut (Fig. 36). Note that cap screw is installed from the outside toward the center of the machine.

11. Remove plugs that were installed to hydraulic hoses and fittings during the removal procedure.

12. Using labels placed during the removal process, properly connect hydraulic hoses to transmission, gear pump and hydraulic tank fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

13. Lubricate gasket of new oil filter and install filter on transmission.

14. Make sure that drain plugs are properly installed in hydraulic tank and transmission. Fill hydraulic tank with **new** hydraulic fluid.

15. Install operator seat and seat base (see Operator Seat Installation in the Service and Repair section of Chapter 6 – Chassis).

16. Plug wire harness electrical connectors to solenoid valve coil and seat switch. Secure harness to frame.

17. Check parking brake and brake switch operation.

18. Adjust traction drive for neutral.

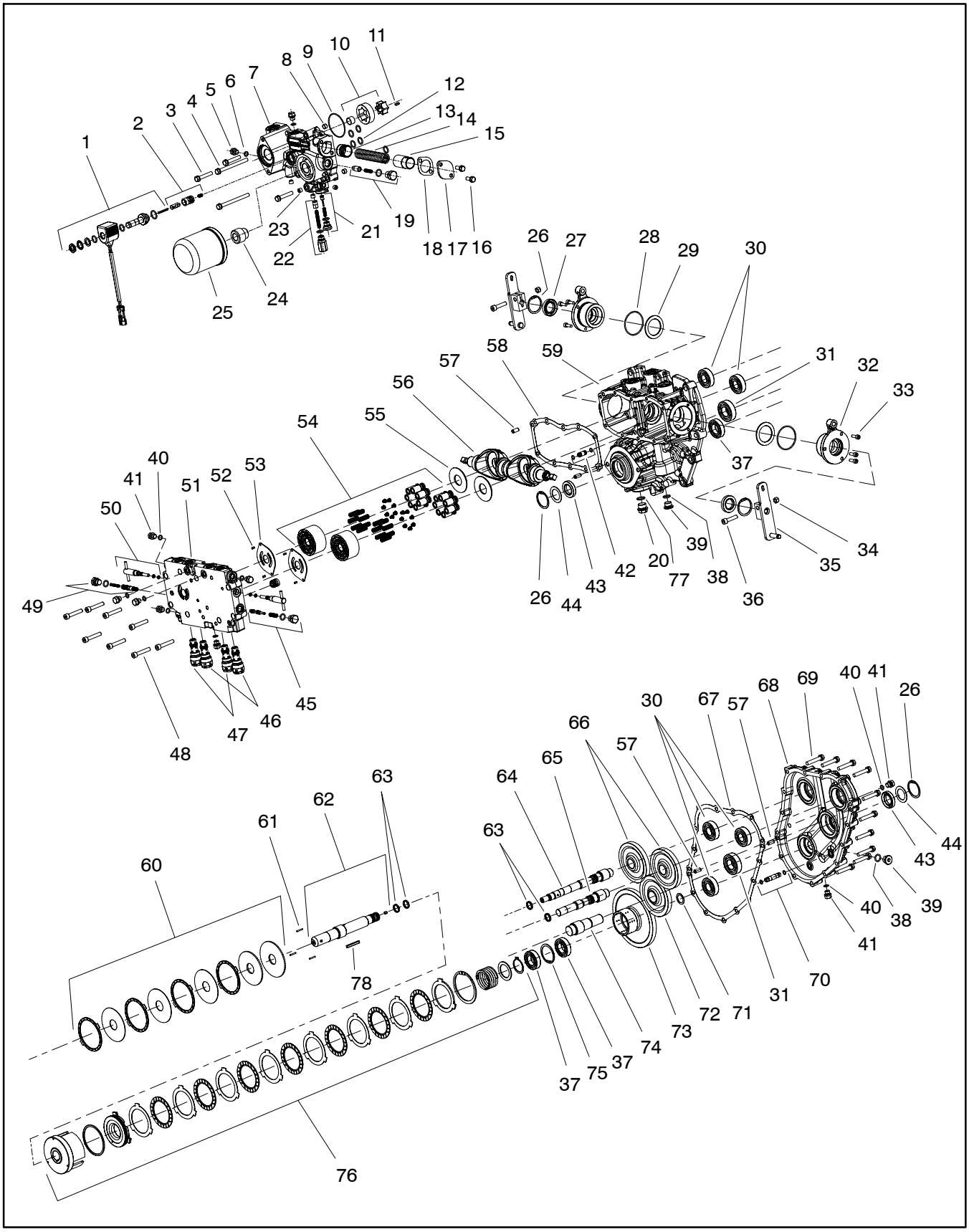
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Figure 39

Figure 39 (continued)

1. Solenoid assembly
2. Solenoid valve assembly
3. Bolt (3 used)
4. Bolt (2 used)
5. Hex plug (2 used)
6. O–ring
7. Pump body
8. Pin (2 used)
9. O–ring
10. Charge pump assembly
11. Key
12. O–ring (5 used)
13. Piston
14. Spring
15. Collar
16. Bolt and washer (2 used)
17. Accumulator cover
18. Gasket
19. Filter bypass valve assembly
20. Hex drain plug
21. Charge relief valve assembly
22. Pressure valve assembly
23. Socket head plug (4 used)
24. Filter adapter
25. Oil filter
26. Retaining ring (4 used)
27. Seal (4 used)
28. O–ring (2 used)
29. Washer (2 used)
30. Bearing (5 used)
31. Bearing (2 used)
32. Side cover (2 used)
33. Socket head screw (3 used per cover)
34. Nut (2 used)
35. Control arm (2 used)
36. Socket head screw (2 used)
37. Bearing (3 used)
38. O–ring (2 used)
39. Socket head plug (2 used)
40. O–ring (8 used)
41. Hex plug (8 used)
42. Pipe assembly
43. Seal (2 used)
44. Washer (2 used)
45. LH flushing valve
46. Reverse relief valve (2 used)
47. Forward relief valve (2 used)
48. Socket head screw (8 used)
49. RH flushing valve
50. Bypass valve (2 used)
51. Center case
52. Pin (4 used)
53. Valve plate (2 used)
54. Cylinder block assembly (2 used)
55. Thrust plate (2 used)
56. Swash plate (2 used)
57. Pin (4 used)
58. Gasket
59. Pump housing
60. PTO brake assembly
61. Push rod (3 used)
62. PTO shaft
63. Seal ring (4 used)
64. RH pump shaft
65. LH pump shaft
66. Pump gear (2 used)
67. Gasket
68. Gear case housing
69. Flange head screw (13 used)
70. Pipe assembly
71. Spacer
72. Input gear
73. PTO gear
74. Input shaft
75. Retaining ring
76. Clutch assembly
77. O–ring
78. Key

IMPORTANT: If a transmission failure occurred, refer to Traction Circuit (Closed Loop) Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

Transmission Disassembly (Fig. 39)

1. Thoroughly clean exterior of transmission.

2. Remove nut, lock washer, washer, O–ring, solenoid coil and O–ring from solenoid valve stem. For assembly purposes, note that “KANZAKI” molded into the coil has the “I” nearest the nut location as coil direction is important for proper solenoid operation.

3. Remove solenoid valve stem from transmission pump body.

4. Remove pin from spool. Remove spool, sleeve and solenoid valve spring from transmission pump body. For assembly purposes, note that step in spool is toward spring location and that sleeve is installed so that holes are closest to the spring location as well.

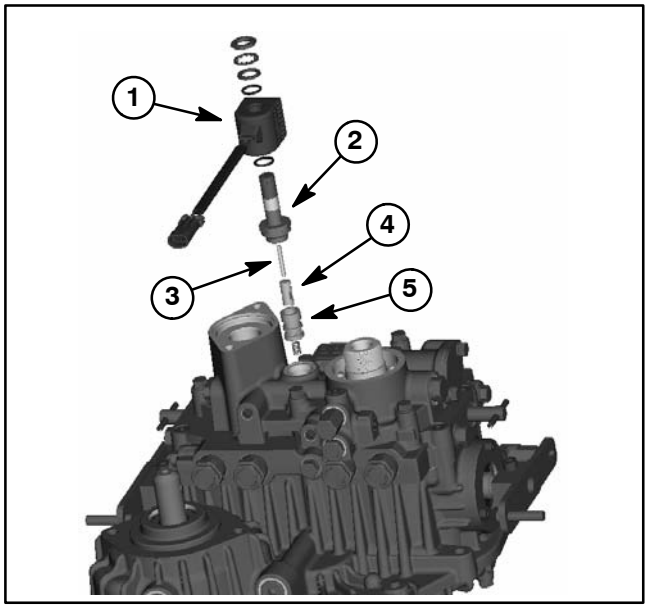

Figure 40

1. Solenoid coil
2. Solenoid valve stem
3. Pin
4. Spool
5. Sleeve

5. Remove filter bypass plug, spring and valve from transmission pump body. Remove and discard O–ring from plug.

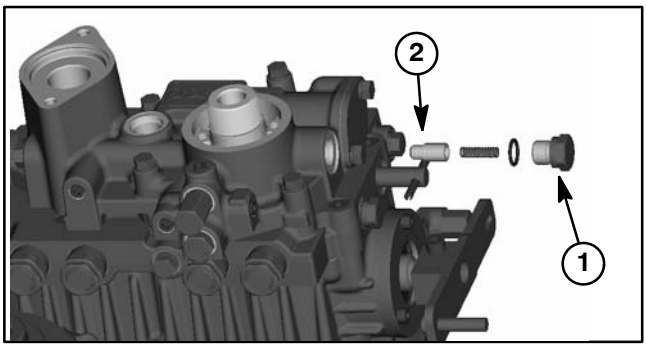

Figure 41

1. **Filter bypass plug**
2. **Bypass valve**

6. Remove pressure valve plug, spring and valve from transmission pump body. Remove and discard O–ring from plug.

7. Remove charge relief plug, spring and valve from transmission pump body. Remove and discard O–ring from plug.

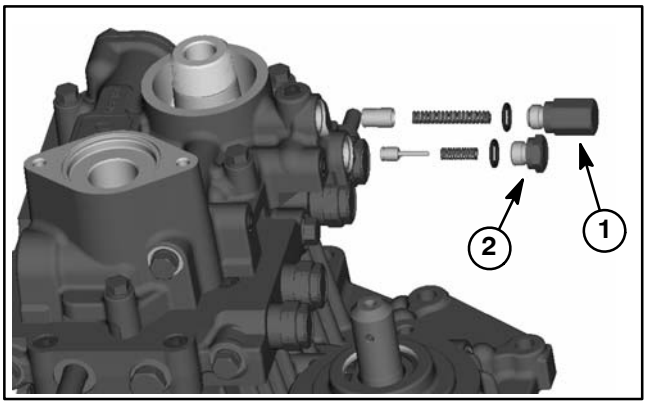

Figure 42

1. **Pressure valve plug**
2. **Charge relief plug**

8. Remove two (2) bolts that secure accumulator cover to transmission pump body.

9. Remove cover, gasket, collar, spring and piston from pump body. For assembly purposes, note that hole in collar is toward the outside of the pump body. Discard gasket.

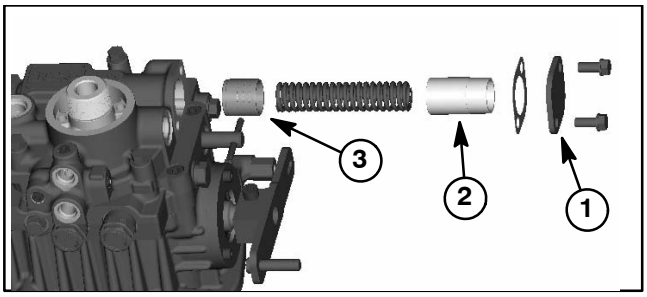

Figure 43

1. **Accumulator cover**
2. **Collar**
3. **Piston**

10. Remove two (2) hex plugs from pump body. Remove and discard O–rings from plugs.

11. Remove four (4) socket head plugs from pump body.

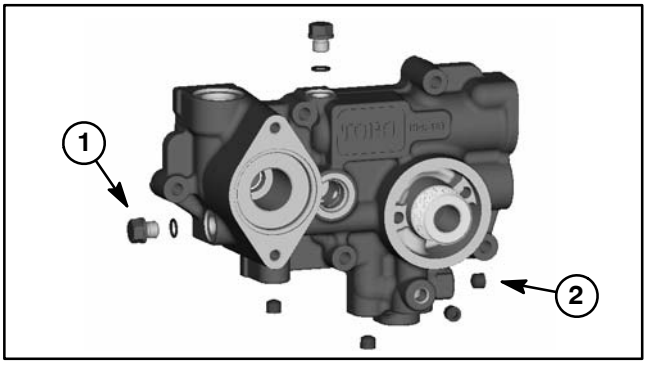

Figure 44

1. **Hex plug (2 used)**
2. **Socket plug (4 used)**

12. Remove three (3) shorter (45 mm) and two (2) longer (95 mm) flange head screws that secure pump body to center case. Remove pump body from center case.

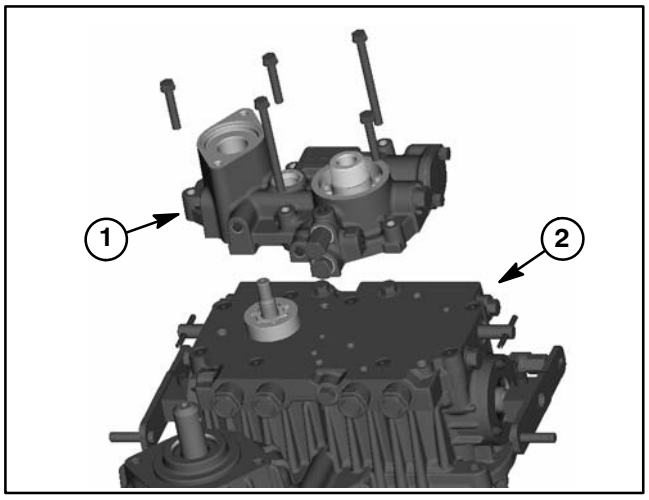

Figure 45

1. **Pump body**
2. **Center case**

13. Remove two (2) pins that locate pump body. Remove and discard O–rings.

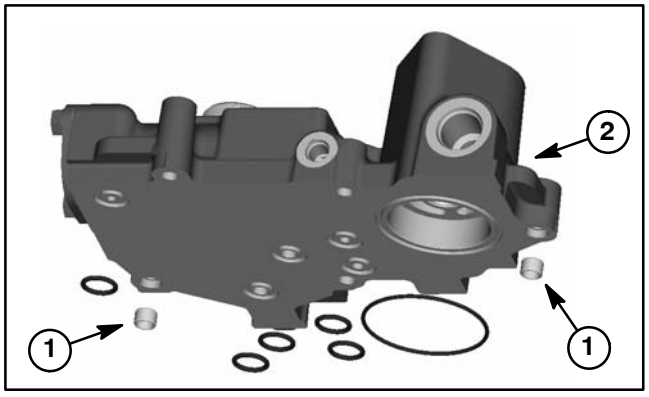

Figure 46

1. **Pin**
2. **Pump body**

14. Slide outer and inner charge pump rotors from RH pump shaft. Remove key from keyslot in pump shaft.

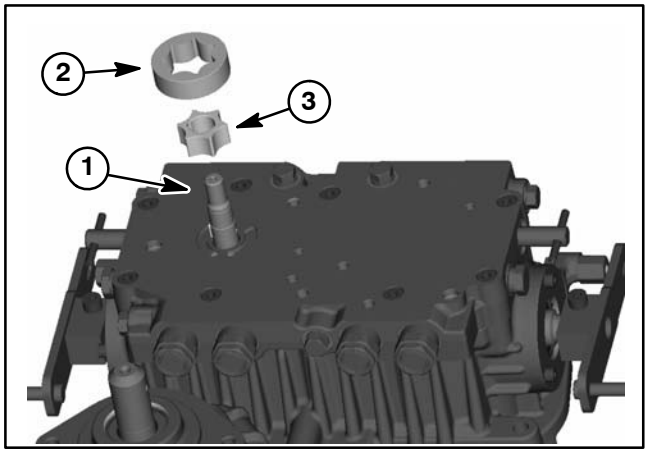

Figure 47

1. **RH pump shaft**
2. **Outer pump rotor**
3. **Inner pump rotor**

15. Remove eight (8) socket head screws that secure center case to transmission pump housing.

16. Carefully remove center case assembly from transmission pump housing.

17. Remove two (2) pins from transmission pump housing bores. Remove and discard gasket.

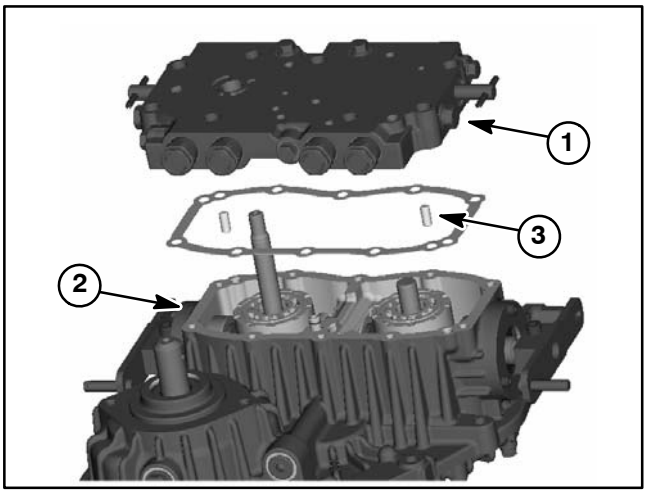

Figure 48

1. **Center case**
2. **Pump housing**
3. **Pin (2 used)**

18. Remove bypass valves from center case. Remove and discard O–rings and backup rings from bypass valves.

IMPORTANT: The forward and reverse relief cartridges are different. Label the relief cartridges for assembly purposes.

19. Remove forward and reverse relief valve cartridges from center case noting relief cartridge location for assembly purposes. The reverse relief valve cartridges can be identified by the groove in the hex head (Fig. 50).

20. Remove valve plates from center case. Mark the positions of the valve plates so they can be assembled in the same position.

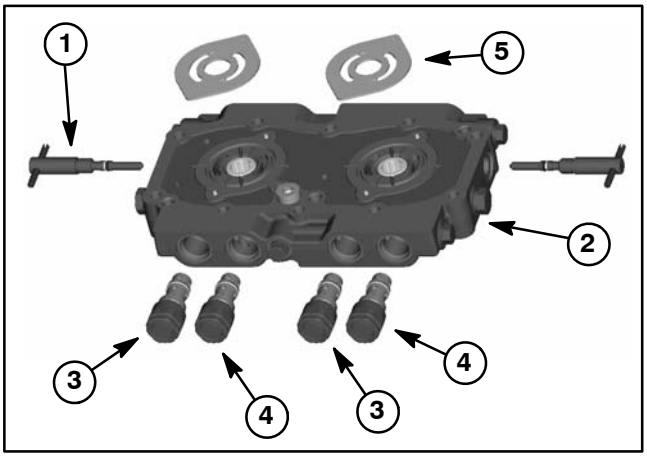

Figure 49

1. **Bypass valve**
2. **Center case**
3. **Reverse relief cartridge**
4. **Forward relief cartridge**
5. **Valve plate**

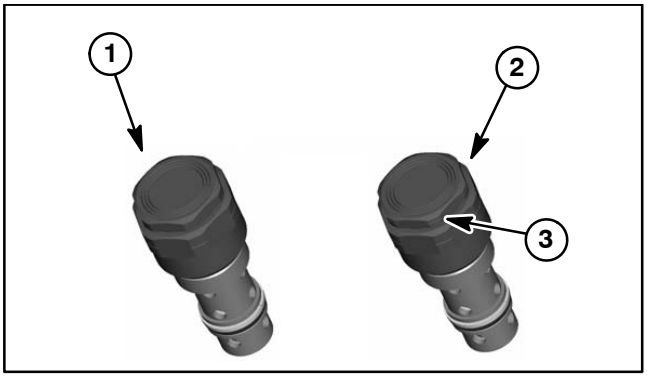

Figure 50

1. **Forward relief cartridge**
2. **Reverse relief cartridge**
3. **Hex head groove**

21. Remove six (6) hex plugs from center case. Remove and discard O–rings from plugs.

22. Remove RH and LH flushing valve plugs, springs and valves from center case. Note differences in flushing valves and their locations for assembly purposes. Remove and discard O–rings from plugs.

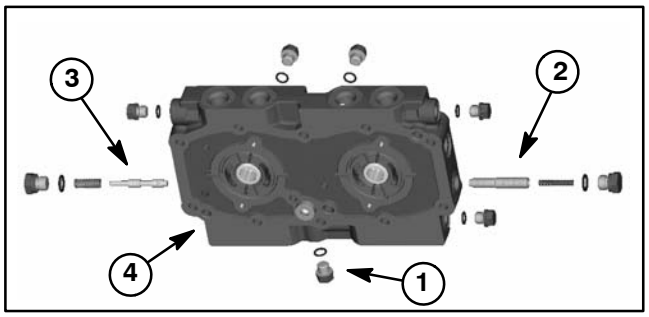

Figure 51

1. Hex plug (6 used)
2. RH flushing valve
3. LH flushing valve
4. Center case

23. Taking care to not drop pistons from cylinder block, slide both cylinder block assemblies from pump shafts. Mark the positions of the cylinder blocks so they can be assembled in the same position.

24. Slide pipe assembly from bore of transmission pump housing. Remove and discard O–rings from grooves in pipe.

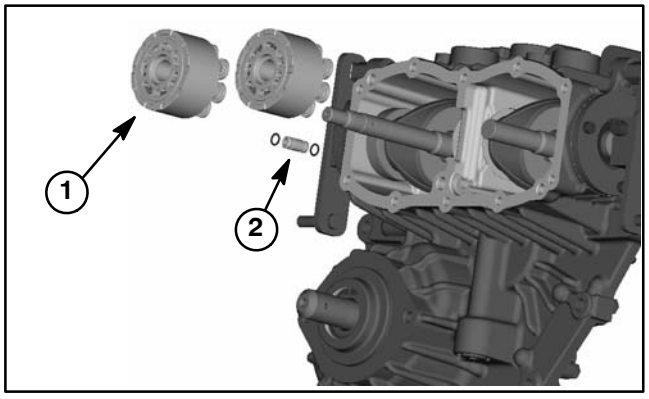

Figure 52

1. Cylinder block assembly
2. Pipe

25. Remove retaining ring that secures PTO shaft oil seal into housing bore. Remove spacer and oil seal from housing taking care to not damage housing bore.

26. Remove thrust plate from each swash plate. For assembly purposes, note that the beveled sides of the thrust plates are against the swash plate surfaces.

27. Remove socket head screw and nut that secures control arm onto each trunnion shaft. Slide control arm from each trunnion shaft.

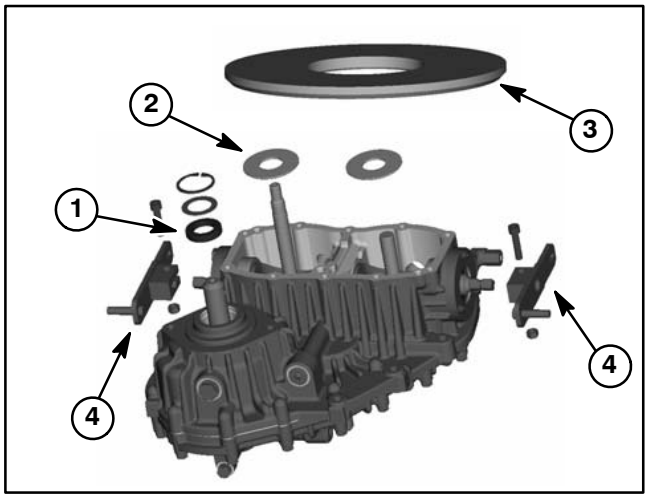

Figure 53

1. Oil seal
2. Thrust plate
3. Thrust plate bevel
4. Control arm

28. Remove two (2) hex plugs and one (1) socket head plug from gear case housing. Remove and discard O–rings from plugs.

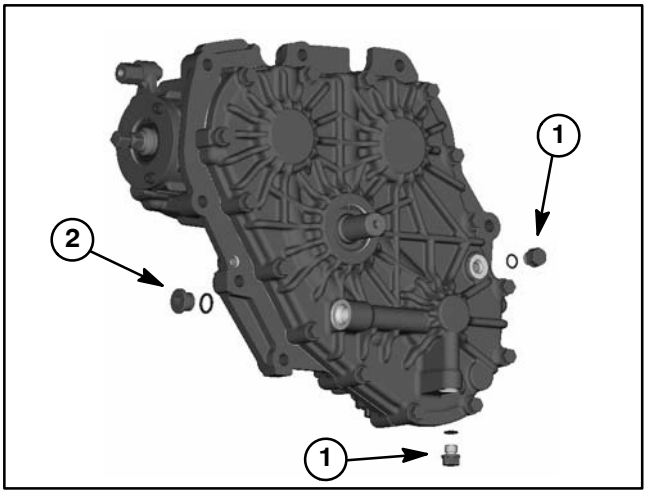

Figure 54

1. **Hex plug**
2. **Socket head plug**

29. Remove fifteen (15) flange head screws that secure gear case housing to transmission pump housing.

30. Carefully remove gear case housing from pump housing.

31. Locate and retrieve two (2) pins from gear case housing holes. Remove and discard gasket.

32. Remove retaining ring that secures input shaft oil seal into gear case housing bore. Remove spacer and oil seal from housing taking care to not damage seal bore in housing. Discard seal.

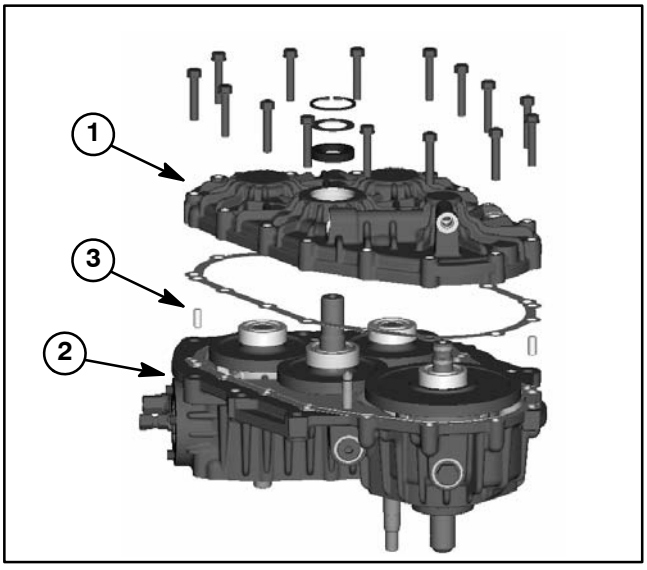

Figure 55

1. **Gear case housing**
2. **Pump housing**
3. **Pin (2 used)**

33. Remove input shaft, RH pump shaft and LH pump shaft assemblies from transmission pump housing.

34. Slide pipe assembly from bore of pump housing. Remove and discard two (2) O–rings from grooves in pipe.

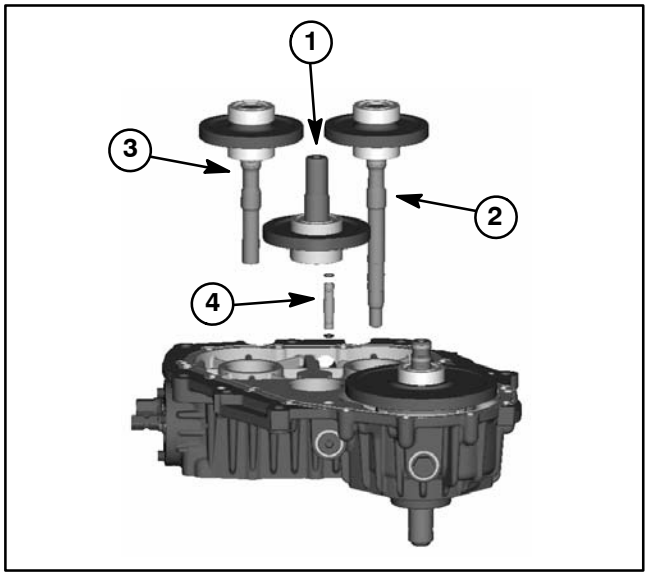

Figure 56

1. Input shaft
2. RH pump shaft
3. LH pump shaft
4. Pipe

35. If pump shaft bearing replacement is necessary, remove and discard seal ring from RH and LH pump shafts. Remove bearings from pump shaft using a bearing puller. Discard removed bearings. Remove gear from pump shaft.

36. If input shaft bearing replacement is necessary, remove bearings from input shaft using a bearing puller. Discard removed bearings. Remove gear from input shaft.

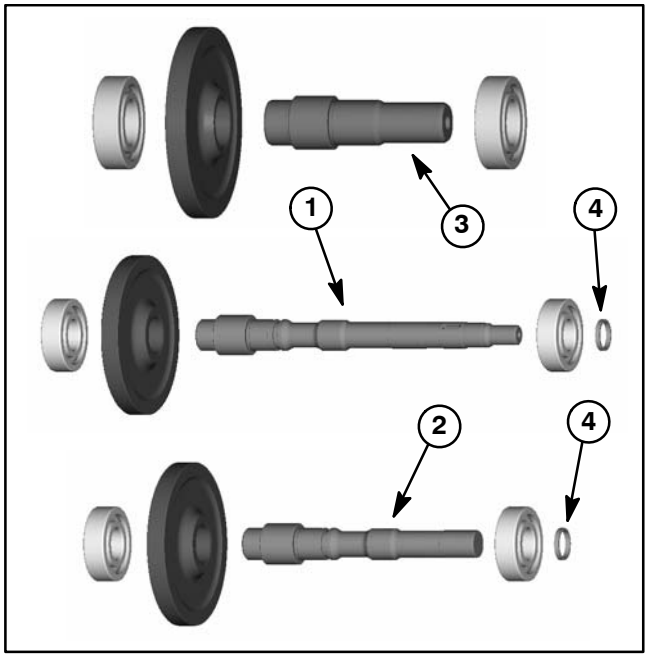

Figure 57

1. RH pump shaft
2. LH pump shaft
3. Input shaft
4. Seal ring

37. Remove PTO shaft assembly from transmission pump housing.

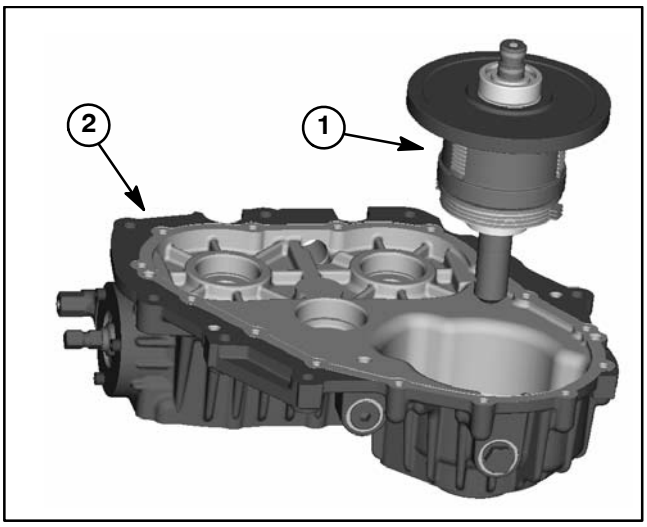

Figure 58

1. PTO shaft assembly **2. Pump housing**

38. Remove final friction plate from transmission pump housing.

NOTE: This friction plate may have been removed with PTO shaft assembly.

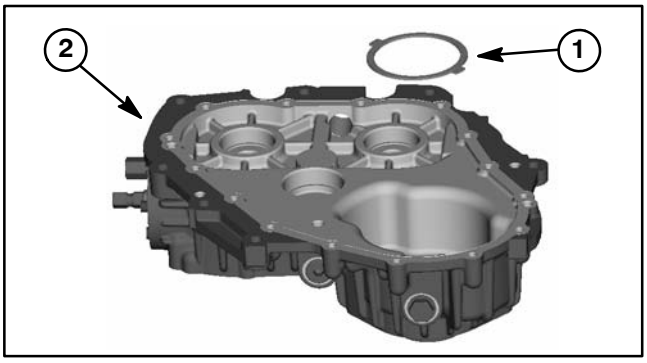

Figure 59

1. Friction plate **2. Pump housing**

39. Disassemble PTO shaft assembly:

A. Using a bearing puller, remove bearing from PTO shaft. Discard bearing.

B. Remove spacer from PTO shaft.

C. Slide gear and clutch assembly from PTO shaft.

D. Remove key from PTO shaft slot.

E. Remove two (2) seal rings from PTO shaft grooves. Discard seal rings.

F. Remove B–plate, C–plate, three (3) A–plates and three (3) friction plates from PTO shaft.

G. Using a bearing puller, remove bearing from PTO shaft. Discard bearing.

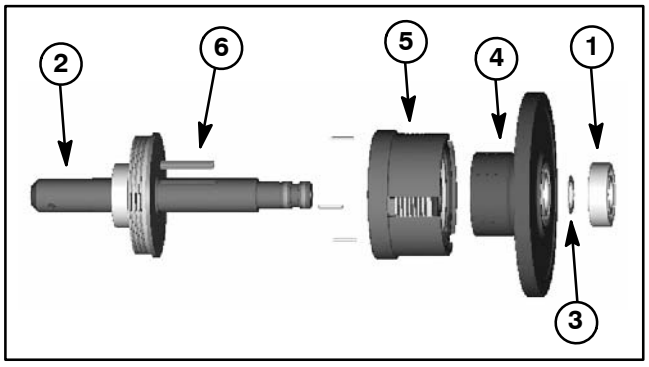

Figure 60

1. Bearing
2. PTO shaft
3. Spacer
4. Gear
5. Clutch assembly
6. Key

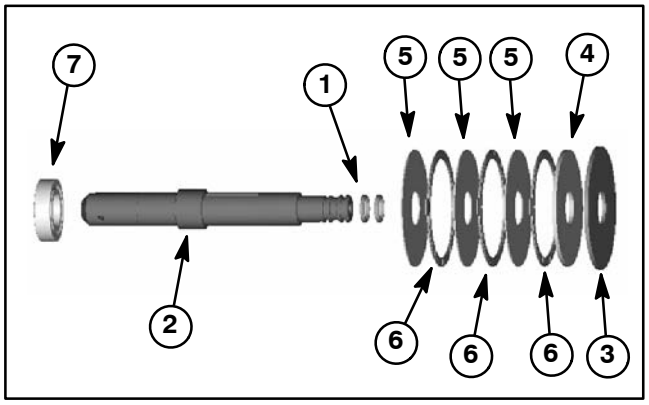

Figure 61

1. Seal ring (2 used)
2. PTO shaft
3. B–plate
4. C–plate
5. A–plate (3 used)
6. Friction plate (3 used)
7. Bearing

40. Slide three (3) rods from holes in clutch assembly.

41. Slide PTO gear assembly from clutch assembly.

NOTE: Because individual clutch components are not available, disassembly of the clutch assembly is not necessary.

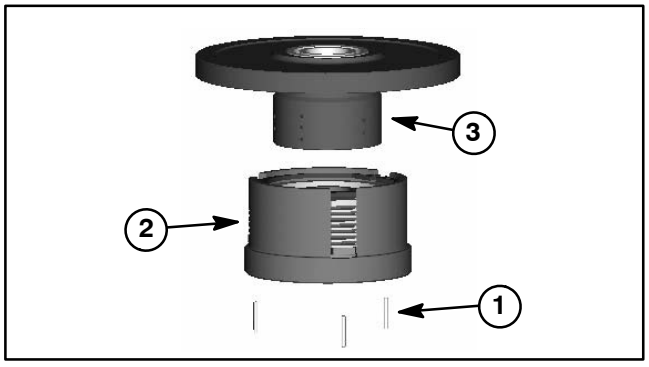

Figure 62

1. Rod (3 used)
2. Clutch assembly
3. PTO gear

42. If necessary, remove two (2) bearings from PTO gear. Discard removed bearings. Remove retaining ring from groove in PTO gear bore.

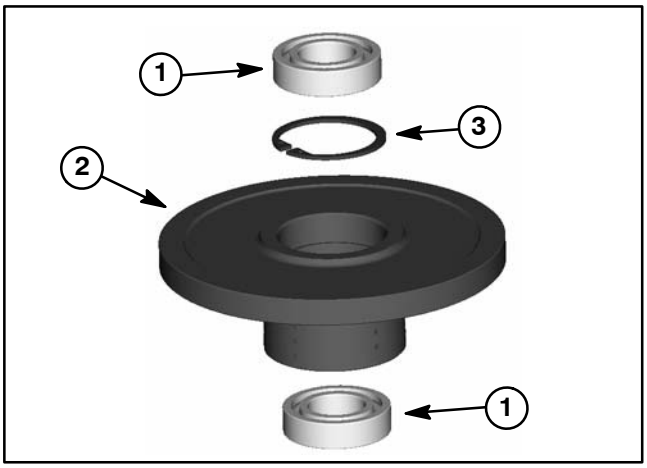

Figure 63

1. Bearing
2. PTO gear
3. Retaining ring

43. Remove two (2) plugs from transmission pump housing. Remove and discard O–rings from plugs.

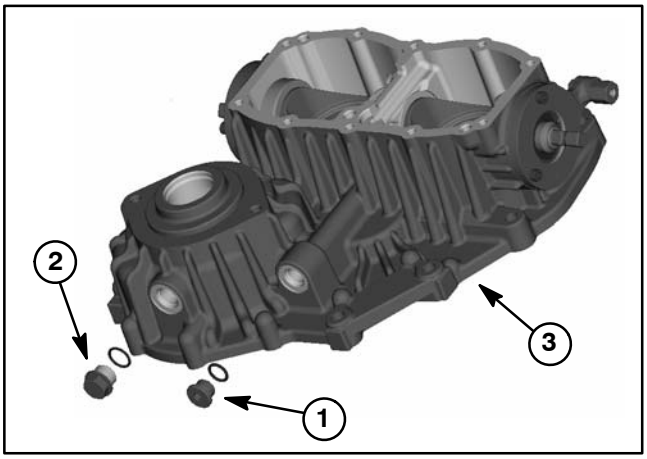

Figure 64

1. Socket head plug
2. Hex plug
3. Pump housing

44. Remove three (3) socket head screws that secure both side covers to transmission pump housing.

45. Carefully slide side covers from trunnion shafts and housing. Remove and discard O–rings from side covers.

46. Remove retaining rings that secure oil seals into both side covers. Remove oil seals from side covers. Discard seals.

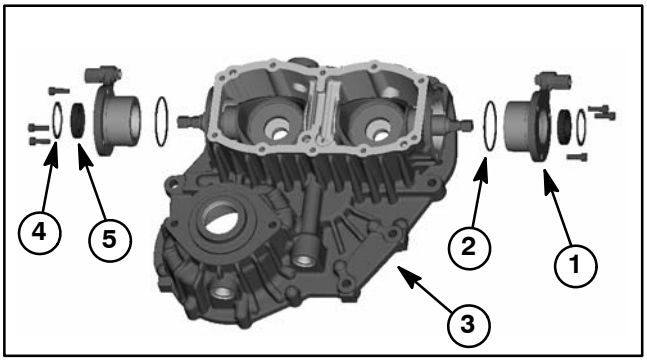

Figure 65

1. Side cover
2. O–ring
3. Pump housing
4. Retaining ring
5. Oil seal

47. Carefully remove swash plates from transmission pump housing. Remove washer from each swash plate.

48. Thoroughly clean and inspect all transmission components.

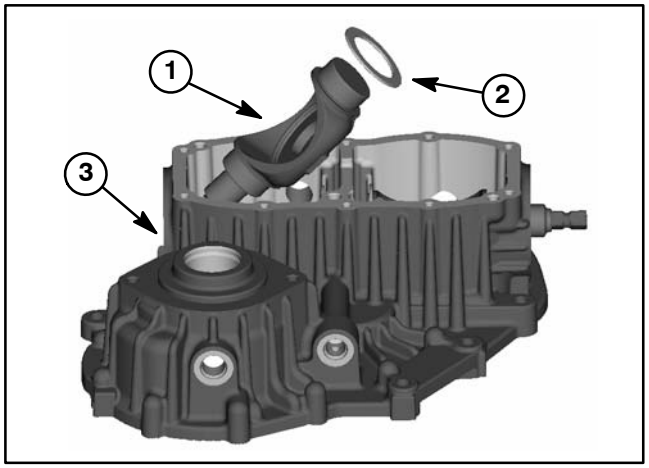

Figure 66

1. **Swash plate (2 used)**
2. **Washer**
3. **Pump housing**

Transmission Assembly (Fig. 39)

IMPORTANT: When assembling the transmission, lubricate all transmission components with clean hydraulic oil.

1. Make sure that all transmission components are thoroughly clean before assembling the transmission.

2. Apply clean hydraulic oil to washers and swash plate surfaces. Install washer onto each swash plate and carefully install swash plates into transmission pump housing.

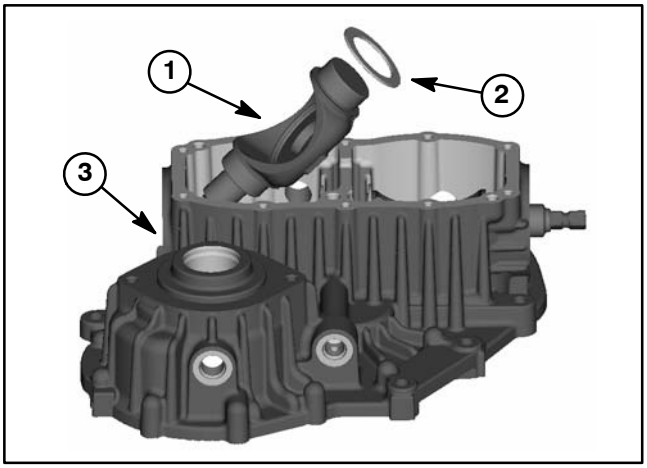

Figure 67

1. **Swash plate (2 used)**
2. **Washer**
3. **Pump housing**

3. Press oil seal into both side covers and secure with retaining ring. Lubricate new O–rings and install onto side covers.

4. Carefully slide side covers over trunnion shafts taking care to not damage seals. Secure both side covers to transmission pump housing with three (3) socket head screws. Torque screws from **78 to 95 in–lb (8.8 to 10.8 N–m)**.

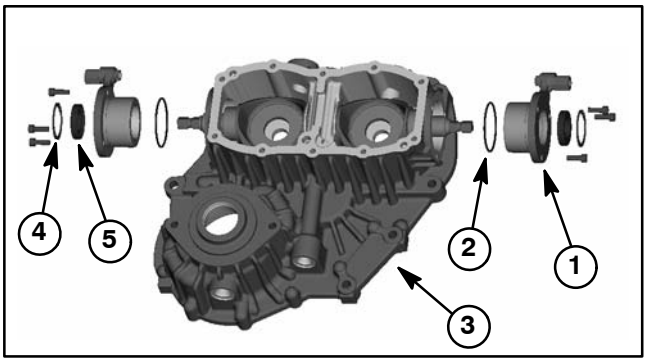

Figure 68

1. **Side cover**
2. **O–ring**
3. **Pump housing**
4. **Retaining ring**
5. **Oil seal**

5. Lubricate new O–rings and install onto two (2) plugs. Install plugs into transmission pump housing. Torque plugs from **17 to 19 ft–lb (22 to 27 N–m)**.

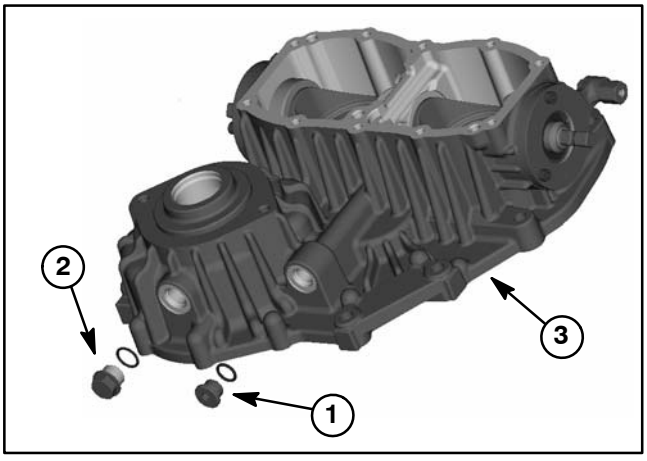

Figure 69

1. **Socket head plug**
2. **Hex plug**
3. **Pump housing**

6. Install retaining ring into groove in bore of PTO gear. Press two (2) bearings into PTO gear until each bearing contacts the installed retaining ring.

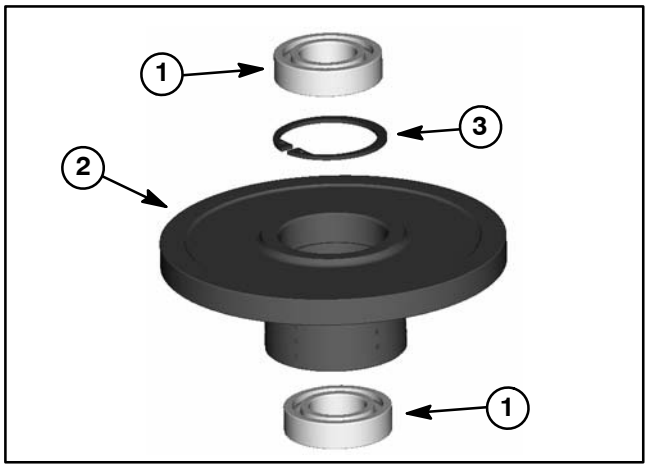

Figure 70

1. Bearing
2. PTO gear
3. Retaining ring

7. Slide three (3) rods into holes in clutch assembly.

8. Slide PTO gear assembly into clutch assembly.

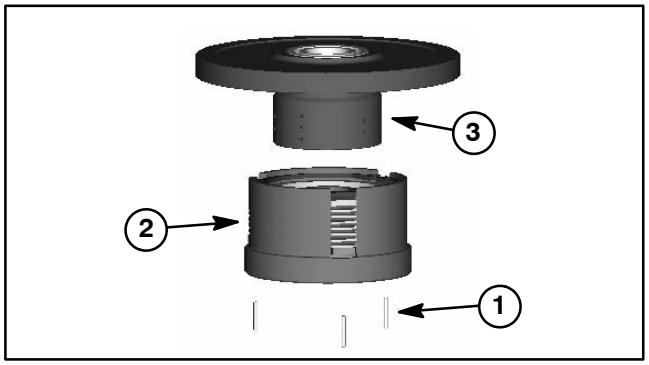

Figure 71

1. Rod (3 used)
2. Clutch assembly
3. PTO gear

9. Assemble PTO shaft:

   A. Press new bearing onto PTO shaft so that bearing is flush with shaft shoulder.

   B. Alternately place three (3) A–plates and three (3) friction plates onto PTO shaft.

   C. Place C–plate and then B–plate onto shaft.

   D. Carefully install two (2) seal rings into grooves of PTO shaft.

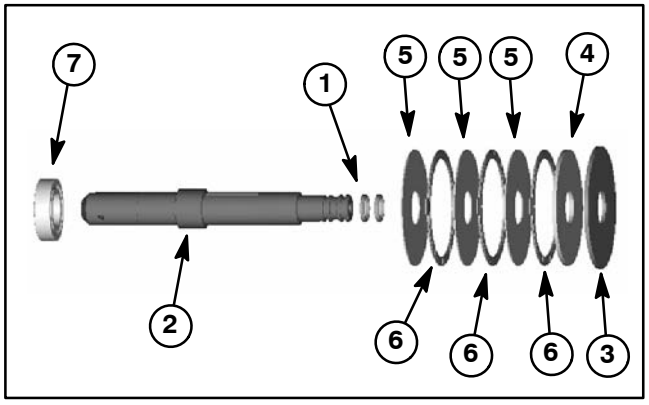

Figure 72

1. Seal ring (2 used)
2. PTO shaft
3. B–plate
4. C–plate
5. A–plate (3 used)
6. Friction plate (3 used)
7. Bearing

10. Install clutch assembly and gear onto PTO shaft:

    A. Install key into PTO shaft slot making sure that rounded ends of key align with rounded ends of shaft slot.

    B. Slide clutch assembly and gear onto PTO shaft making sure to align slot in clutch with key in shaft. Also, align rods in clutch with holes in B–plate.

    C. Place spacer onto PTO shaft.

    D. Press bearing onto PTO shaft so bearing is flush with shaft shoulder.

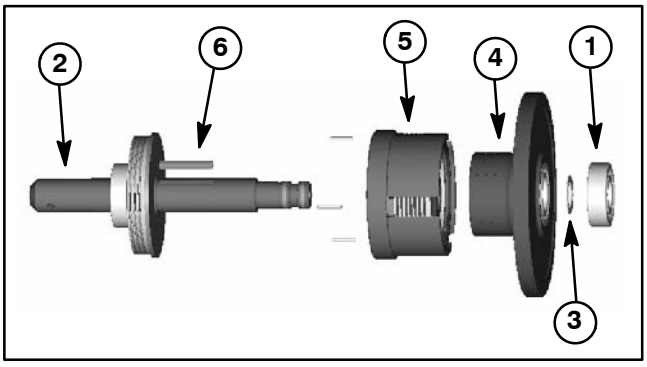

Figure 73

1. **Bearing**
2. **PTO shaft**
3. **Spacer**
4. **Gear**
5. **Clutch assembly**
6. **Key**

11. Apply clean hydraulic oil to friction plate and place in transmission pump housing. Make sure that tabs on friction plate are placed in housing grooves.

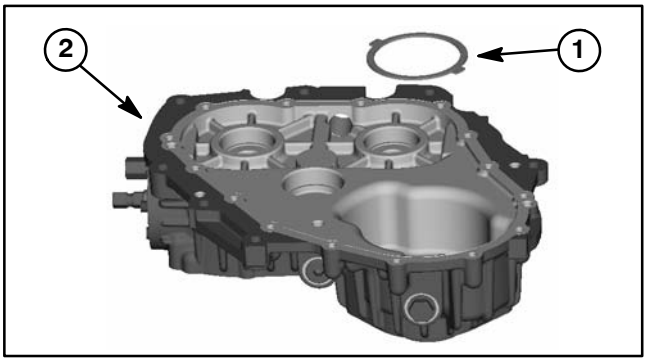

Figure 74

1. **Friction plate**
2. **Pump housing**

12. Install PTO shaft assembly into transmission pump housing. Make sure that tabs on friction plates are placed in housing grooves.

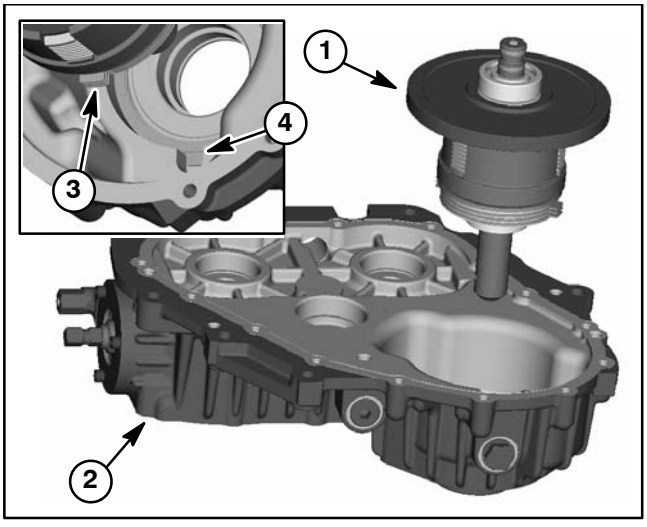

Figure 75

1. **PTO shaft assembly**
2. **Pump housing**
3. **Friction plate tabs**
4. **Housing groove**

13. If shafts were disassembled, install gear and two (2) bearings onto input shaft, RH pump shaft and/or LH pump shaft. Make sure that bearings are pressed fully to the shaft shoulder.

14. Lubricate seal rings and install seal ring onto RH and LH pump shafts.

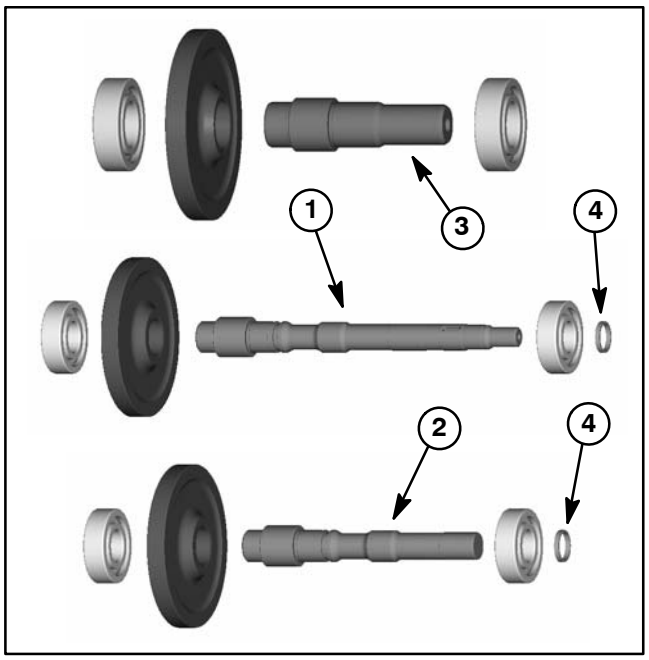

Figure 76

1. **RH pump shaft**
2. **LH pump shaft**
3. **Input shaft**
4. **Seal ring**

15. Install RH and LH pump shaft assemblies into transmission pump housing. Then, install input shaft into pump housing making sure to align input shaft gear teeth with gears on PTO and pump shafts.

16. Lubricate two (2) new O–rings and install O–rings into grooves in pipe. Slide pipe assembly into bore of transmission pump housing.

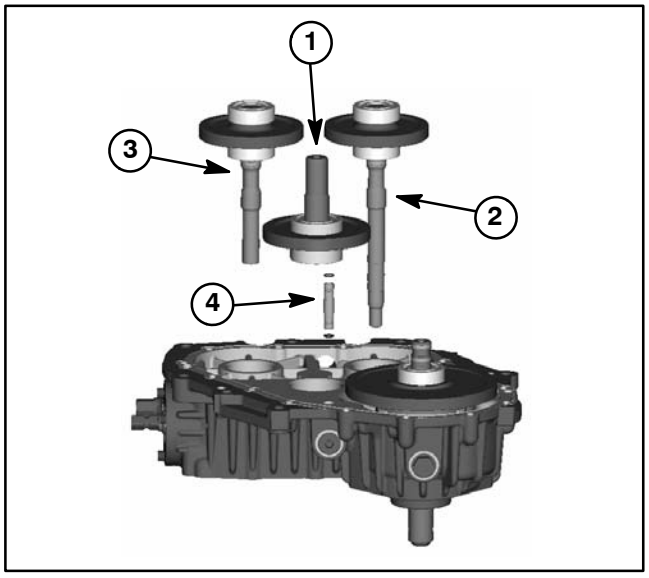

Figure 77

1. **Input shaft**
2. **RH pump shaft**
3. **LH pump shaft**
4. **Pipe assembly**

17. Place two (2) pins into transmission pump housing holes. Position new gasket to housing.

18. Carefully place gear case housing onto pump housing making sure to align pins, pipe and shaft bearings.

19. Secure gear case housing to pump housing with fifteen (15) flange head screws. Tighten screws evenly in a crossing pattern and then torque screws from **17 to 19 ft–lb (22 to 27 N–m)**.

20. Taking care to not damage input shaft oil seal, install oil seal into gear case housing bore. Place spacer on oil seal and secure with retaining ring.

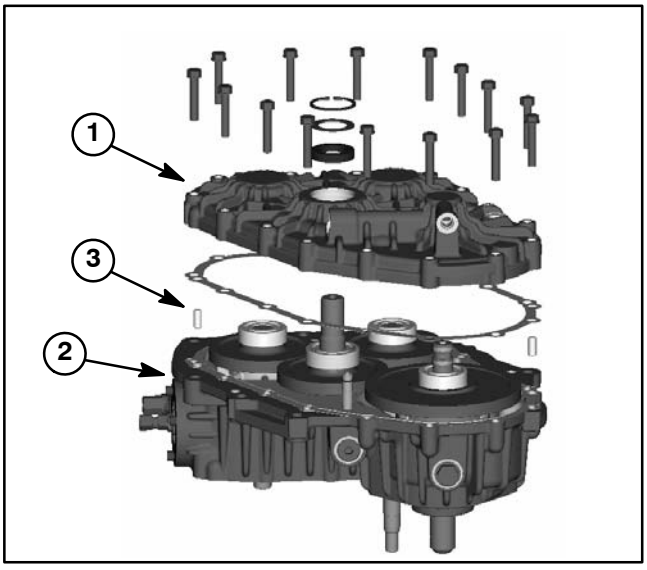

Figure 78

1. **Gear case housing**
2. **Pump housing**
3. **Pin (2 used)**

21. Lubricate new O–rings and install O–rings onto three (3) plugs. Install plugs into transmission assembly. Torque hex plugs from **14 to 15 ft–lb (18 to 21 N–m)** and socket head plug from **17 to 19 ft–lb (22 to 27 N–m)**.

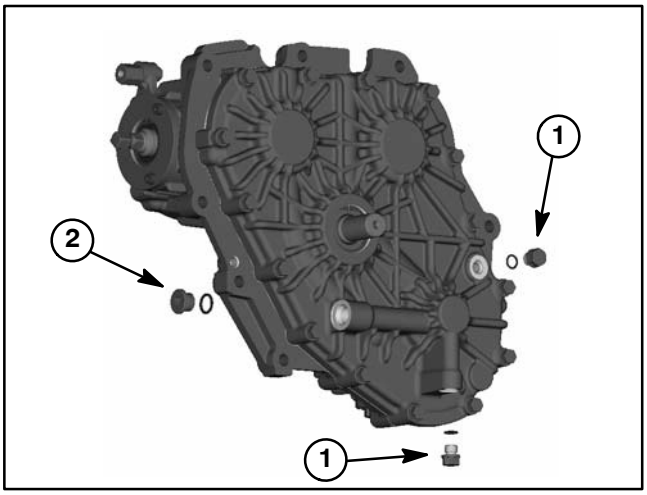

Figure 79

1. **Hex plug**
2. **Socket head plug**

22. Taking care to not damage PTO oil seal, install oil seal into pump housing bore at PTO shaft. Place spacer on oil seal and secure with retaining ring.

23. Lubricate both sides of thrust plates with clean hydraulic oil. Place thrust plate onto each swash plate making sure to position the beveled side of the thrust plates against the swash plate surface.

24. Slide control arm onto each trunnion shaft and secure with socket head screw and nut. Torque nut from **20 to 23 ft–lb (27 to 32 N–m)**.

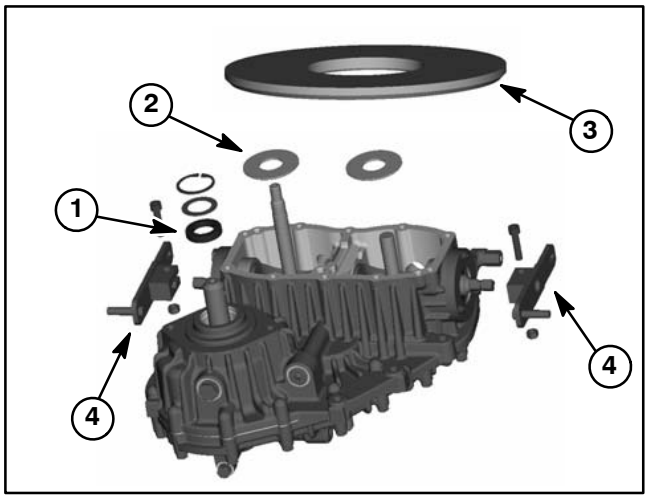

Figure 80

1. **Oil seal**
2. **Thrust plate**
3. **Thrust plate bevel**
4. **Control arm**

25. Lubricate all components of cylinder blocks liberally with clean hydraulic oil. Make sure that all pistons are placed in cylinder blocks. Taking care to not drop pistons from cylinder block, slide both cylinder block assemblies onto pump shafts.

26. Lubricate two (2) new O–rings and install O–rings into grooves in pipe. Slide pipe assembly into bore of transmission pump housing.

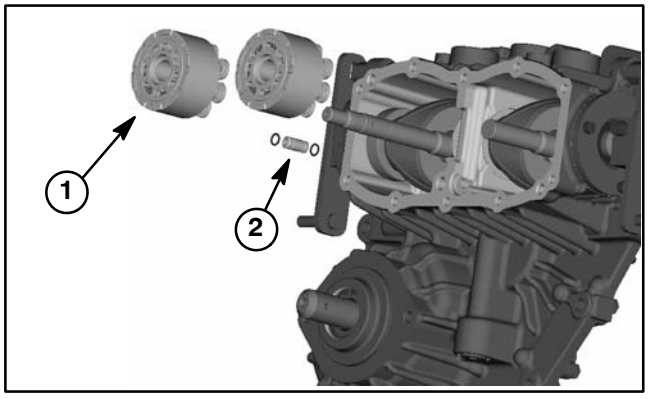

Figure 81

1. **Cylinder block assembly**
2. **Pipe**

27. Lubricate new O–rings and install O–rings onto six (6) hex plugs. Install plugs into center case. Torque plugs from **14 to 15 ft–lb (18 to 21 N–m)**.

28. Lubricate flushing valves with clean hydraulic oil and place them in center case bores making sure to place RH and LH flushing valves in correct location.

29. Lubricate new O–rings and install O–rings on two (2) flushing valve plugs. Install springs and plugs to secure flushing valves. Torque plugs from **17 to 19 ft–lb (22 to 27 N–m)**.

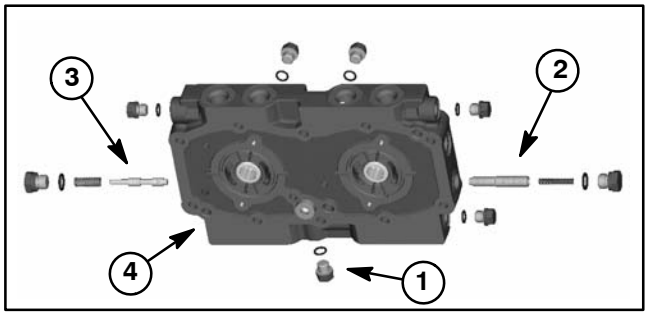

Figure 82

1. **Hex plug (6 used)**
2. **RH flushing valve**
3. **LH flushing valve**
4. **Center case**

30. Lubricate O–rings and backup rings for bypass valves. Position rings on bypass valves and install valves into center case. Torque valves from **62 to 79 in–lb (7 to 9 N–m)**.

31. Lubricate sealing washers and install onto forward and reverse relief valve cartridges.

IMPORTANT: The forward and reverse relief cartridges are different. Use labels made during disassembly to make sure the relief cartridges are properly installed.

32. Thread relief cartridges into correct center case ports and torque from **24 to 27 ft–lb (32 to 37 N–m)**. The reverse relief valve cartridges can be identified by the groove in the hex head (Fig. 84).

33. Apply clean grease to mating surfaces of center case and valve plates to hold valve plates in position during assembly. Install valve plates to dowel pins in center plate.

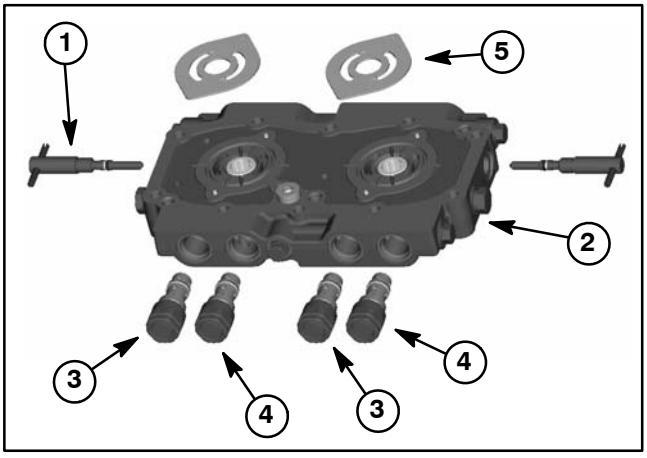

Figure 83

1. **Bypass valve**
2. **Center case**
3. **Reverse relief cartridge**
4. **Forward relief cartridge**
5. **Valve plate**

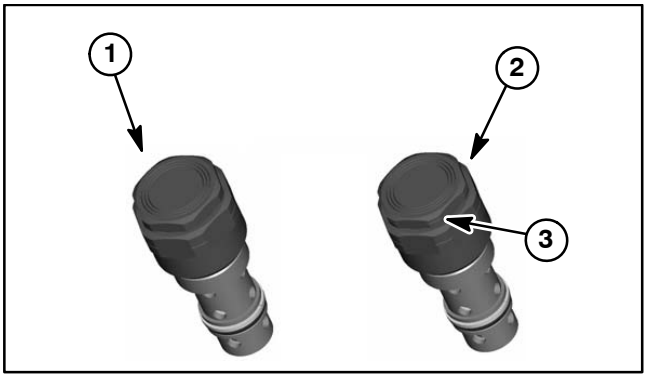

Figure 84

1. **Forward relief cartridge**
2. **Reverse relief cartridge**
3. **Hex head groove**

34. Install two (2) pins into transmission pump housing bores. Position new gasket on pump housing.

35. Position center case assembly to transmission pump housing making sure that valve plates remain in position.

36. Secure center case to transmission pump housing with eight (8) socket head screws. Tighten screws evenly in a crossing pattern and then torque screws from **17 to 19 ft–lb (22 – 27 N–m)**.

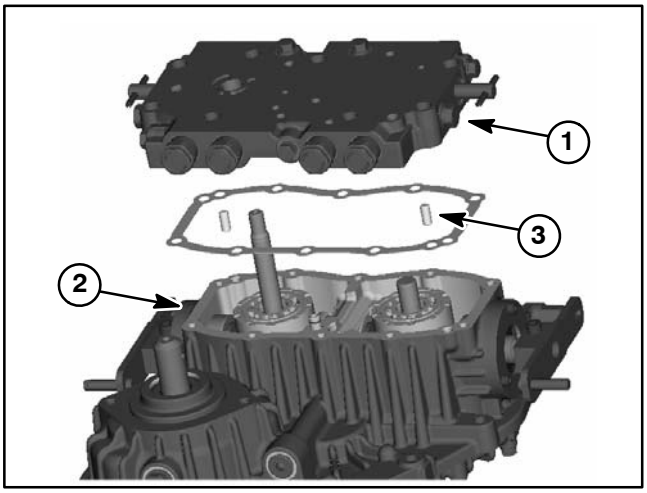

Figure 85

1. **Center case**
2. **Pump housing**
3. **Pin (2 used)**

37. Install key into keyslot in RH pump shaft. Lubricate inner and outer charge pump rotors with clean hydraulic oil. Slide inner rotor onto pump shaft and align with key. Place outer rotor onto inner rotor.

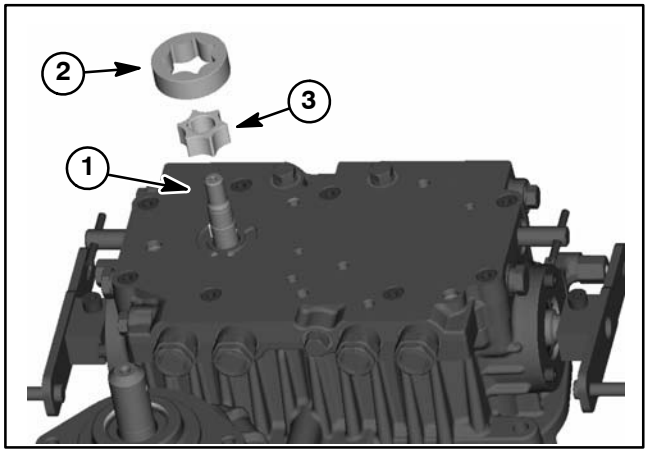

Figure 86

1. **RH pump shaft**
2. **Outer pump rotor**
3. **Inner pump rotor**

38. Install two (2) pins into pump body bores.

39. Apply clean grease to pump body O–rings to hold them in position during assembly. Place O–rings in pump body locations.

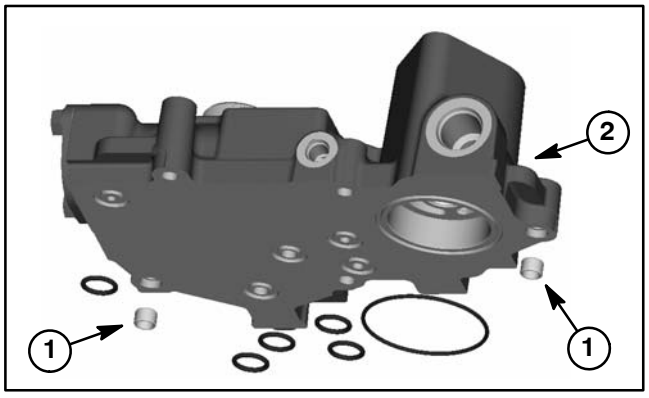

Figure 87

1. **Pin**
2. **Pump body**

40. Place pump body onto center case making sure that O–rings remain in position. Install three (3) shorter and two (2) longer flange head screws to secure pump body to center case. Torque screws in a crossing pattern from **17 to 19 ft–lb (22 to 27 N–m)**.

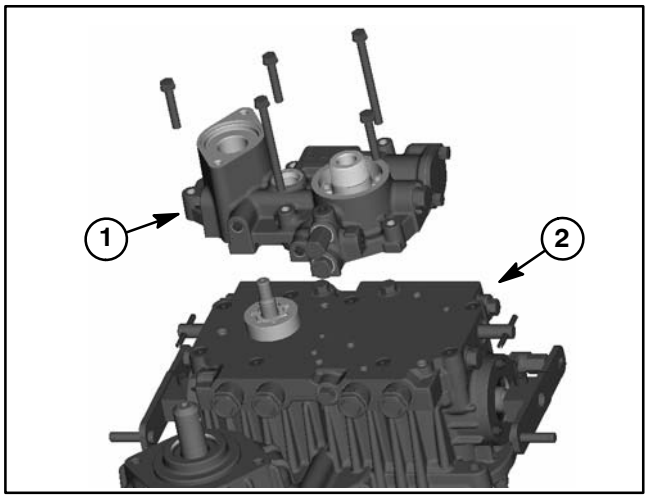

Figure 88

1. **Pump body**
2. **Center case**

41. Lubricate new O–rings and install O–rings onto two (2) hex plugs. Install plugs into pump body. Torque plugs from **14 to 15 ft–lb (18 to 21 N–m)**.

42. Apply sealant to threads of four (4) socket head plugs and install into pump body. Torque plugs from **78 to 95 in–lb (8.8 to 10.8 N–m)**.

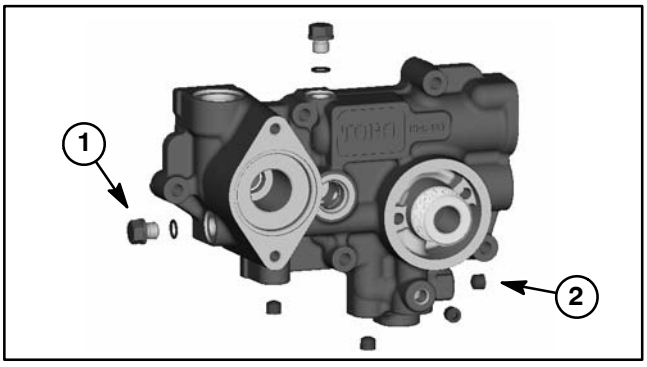

Figure 89

1. **Hex plug (2 used)**
2. **Socket plug (4 used)**

43. Lubricate accumulator components with clean hydraulic oil. Install piston, spring and collar into pump body. Make sure that hole in collar is toward the outside of the pump body.

44. Position new gasket to accumulator cover. Secure cover to pump body with two (2) bolts. Torque bolts from **17 to 19 ft–lb (22 to 27 N–m)**.

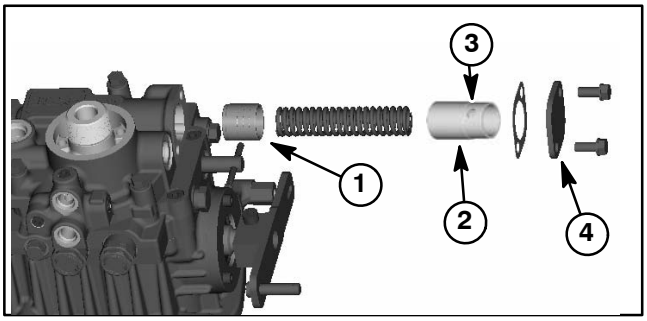

Figure 90

1. **Accumulator piston**
2. **Accumulator collar**
3. **Collar hole**
4. **Accumulator cover**

45. Lubricate charge relief valve and spring with clean hydraulic oil and install into pump body.

46. Lubricate pressure valve and spring with clean hydraulic oil and install into pump body.

47. Lubricate new O–rings and install O–rings onto valve plugs. Install plugs into pump body. Torque plugs from **17 to 19 ft–lb (22 to 27 N–m)**.

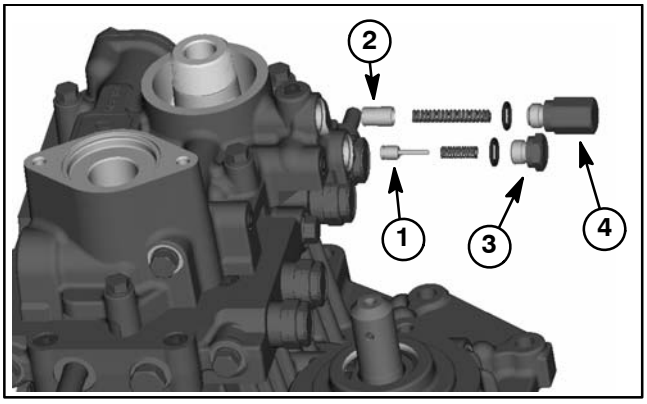

Figure 91

1. **Charge relief valve**
2. **Pressure valve**
3. **Charge relief plug**
4. **Pressure valve plug**

48. Lubricate filter bypass valve and spring with clean hydraulic oil and install into pump body.

49. Lubricate new O–ring and install O–ring onto plug. Install plug into pump body. Torque plug from **17 to 19 ft–lb (22 to 27 N–m)**.

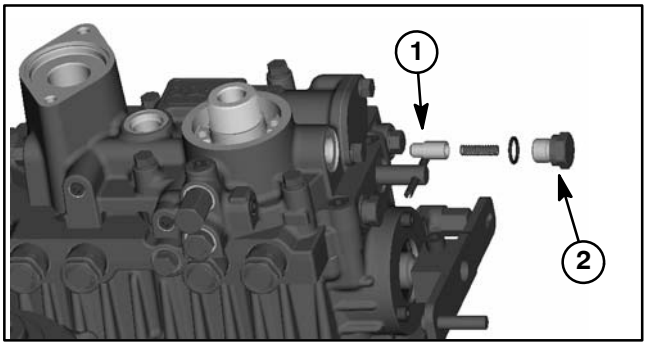

Figure 92

1. **Filter bypass valve**
2. **Filter bypass plug**

50. Lubricate solenoid valve spring, sleeve and spool with clean hydraulic oil and install into pump body. Make sure that sleeve is installed so that holes are closest to the spring location and that step in spool is toward spring location as well. Place pin in spool.

51. Install solenoid valve stem into pump body and torque from **186 to 195 in–lb (21 to 22 N–m)**.

52. Place O–ring, solenoid coil, O–ring, washer, lock washer and nut onto solenoid valve stem. Coil should be installed so the “KANZAKI” molded into the coil has the “I” nearest the nut location. Torque nut from **52 to 69 in–lb (5.9 to 7.8 N–m)**.

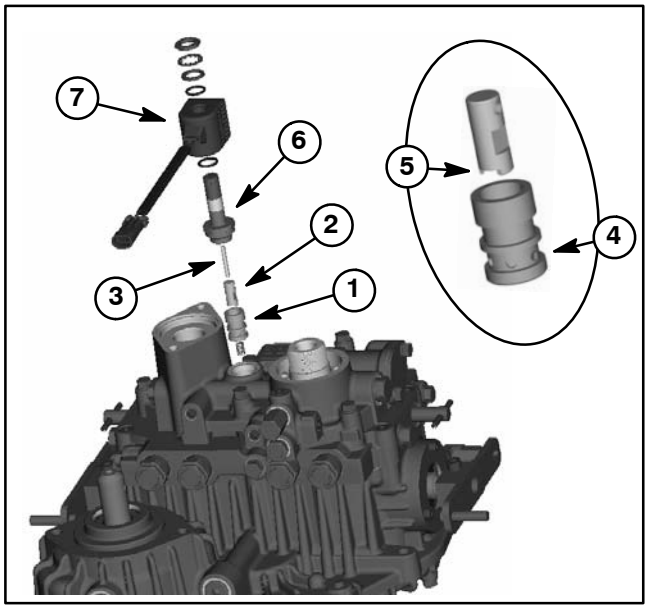

Figure 93

1. **Sleeve**
2. **Spool**
3. **Pin**
4. **Sleeve holes**
5. **Spool step**
6. **Solenoid valve stem**
7. **Solenoid coil**

Gear Pump

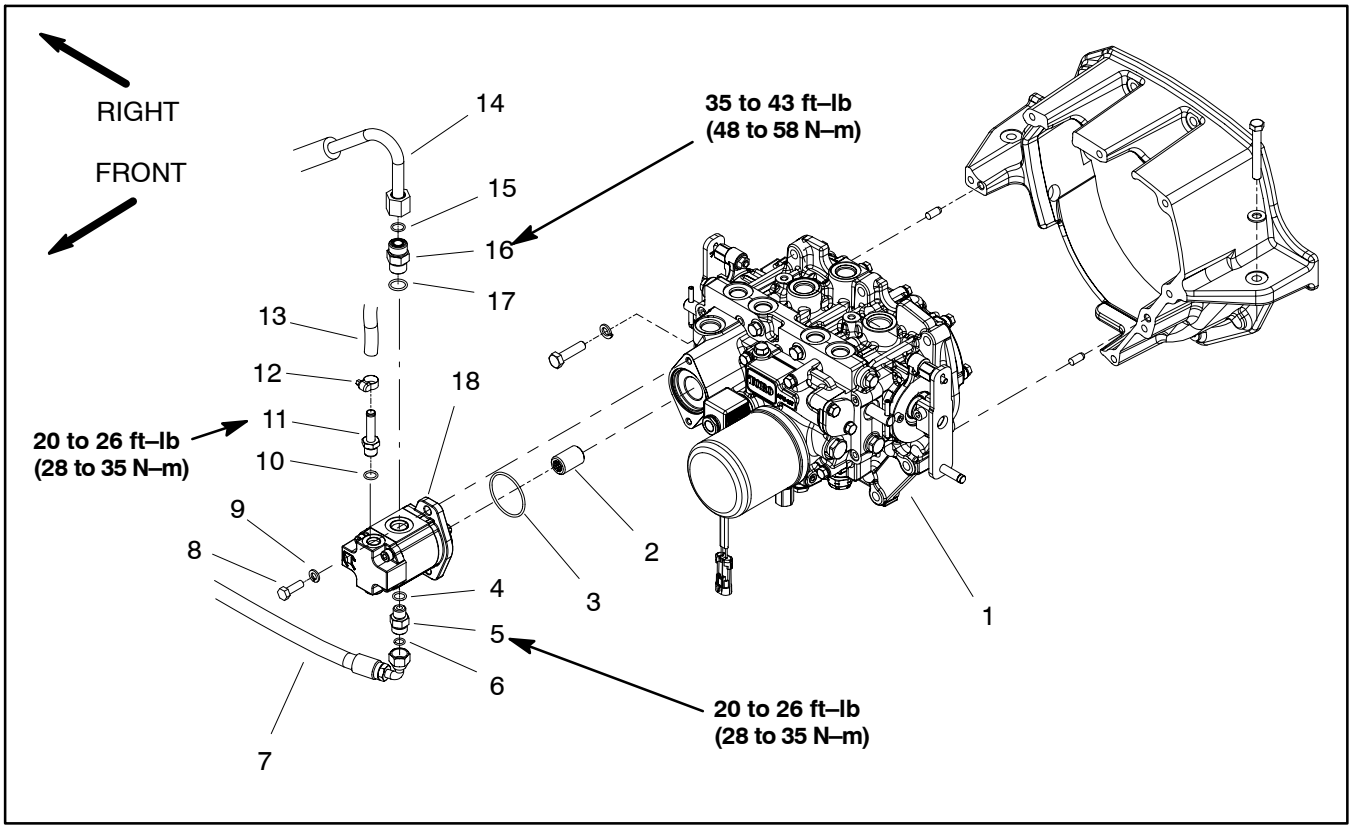

Figure 94

1. Transmission assembly
2. Coupler
3. O–ring
4. O–ring
5. Hydraulic fitting
6. O–ring
7. Hydraulic hose (output)
8. Cap screw (2 used)
9. Lock washer (2 used)
10. O–ring
11. Hydraulic fitting
12. Hose clamp
13. Hydraulic hose
14. Hydraulic hose (suction)
15. O–ring
16. Hydraulic fitting
17. O–ring
18. Gear pump

Removal (Fig. 94)

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Remove operator seat and seat base (see Operator Seat Removal in the Service and Repair section of Chapter 6 – Chassis).

3. Drain hydraulic oil from hydraulic tank.

4. Thoroughly clean hydraulic hose ends and fittings on gear pump and hydraulic tank to prevent hydraulic system contamination.

5. Label all hydraulic hoses and fittings for assembly purposes.

6. Disconnect hydraulic hoses from fittings on the hydraulic tank and gear pump (Fig. 95). Allow hoses to drain into a suitable container. Install clean plugs in hose and fitting openings to prevent system contamination.

7. Remove parking brake handle from machine to allow hydraulic tank repositioning (see Parking Brake Assembly in the Service and Repairs section of Chapter 6 – Chassis).

8. Remove reservoir support that secures hydraulic tank to machine (see Hydraulic Tank Removal in this section). Move hydraulic tank toward front of machine to allow clearance for gear pump removal.

9. Support the gear pump to prevent it from falling during removal.

10. Remove two (2) cap screws and lock washers that secure gear pump to the transmission.

11. Remove gear pump from transmission. Remove and discard O–ring (item 3). Locate and remove coupler from transmission or gear pump shaft.

12. If necessary, remove hydraulic fittings from pump. Remove and discard O–rings from fittings.

Installation (Fig. 94)

1. If hydraulic fittings were removed from pump, lubricate and install new O–rings to fitting. Tighten fittings to torque values identified in Figure 94 (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Slide coupler onto transmission shaft. Lubricate O–ring (item 3) with grease and position on flange of gear pump.

IMPORTANT: Position gear pump to the transmission so that the gear pump suction port is facing up.

3. Position gear pump to the transmission and secure with two (2) cap screws and lock washers.

4. Move hydraulic tank toward rear of machine to its proper position and secure with reservoir support (see Hydraulic Tank Installation in this section).

5. Install parking brake handle to machine (see Parking Brake Assembly in the Service and Repairs section of Chapter 6 – Chassis). Make sure that parking brake switch operation is correct after brake handle is installed.

6. Remove plugs that were installed to hydraulic hoses and fittings during the removal procedure. Attach hydraulic hoses to fittings on gear pump and hydraulic tank using labels placed during removal (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Fill hydraulic tank with **new** hydraulic oil.

8. Install operator seat and seat base (see Operator Seat Installation in the Service and Repair section of Chapter 6 – Chassis).

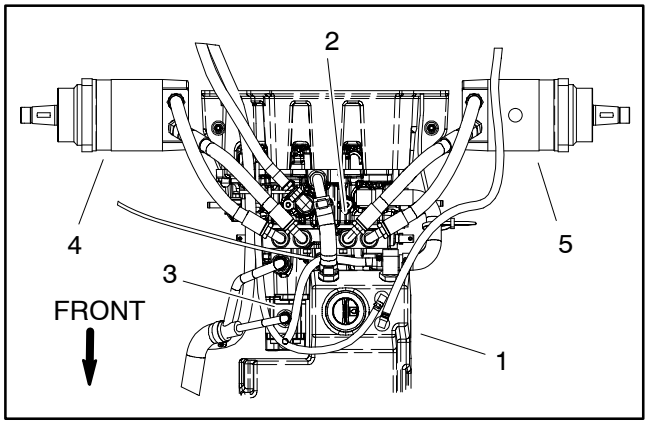

Figure 95

1. **Hydraulic tank**
2. **Transmission**
3. **Gear pump**
4. **RH wheel motor**
5. **LH wheel motor**

Gear Pump Service

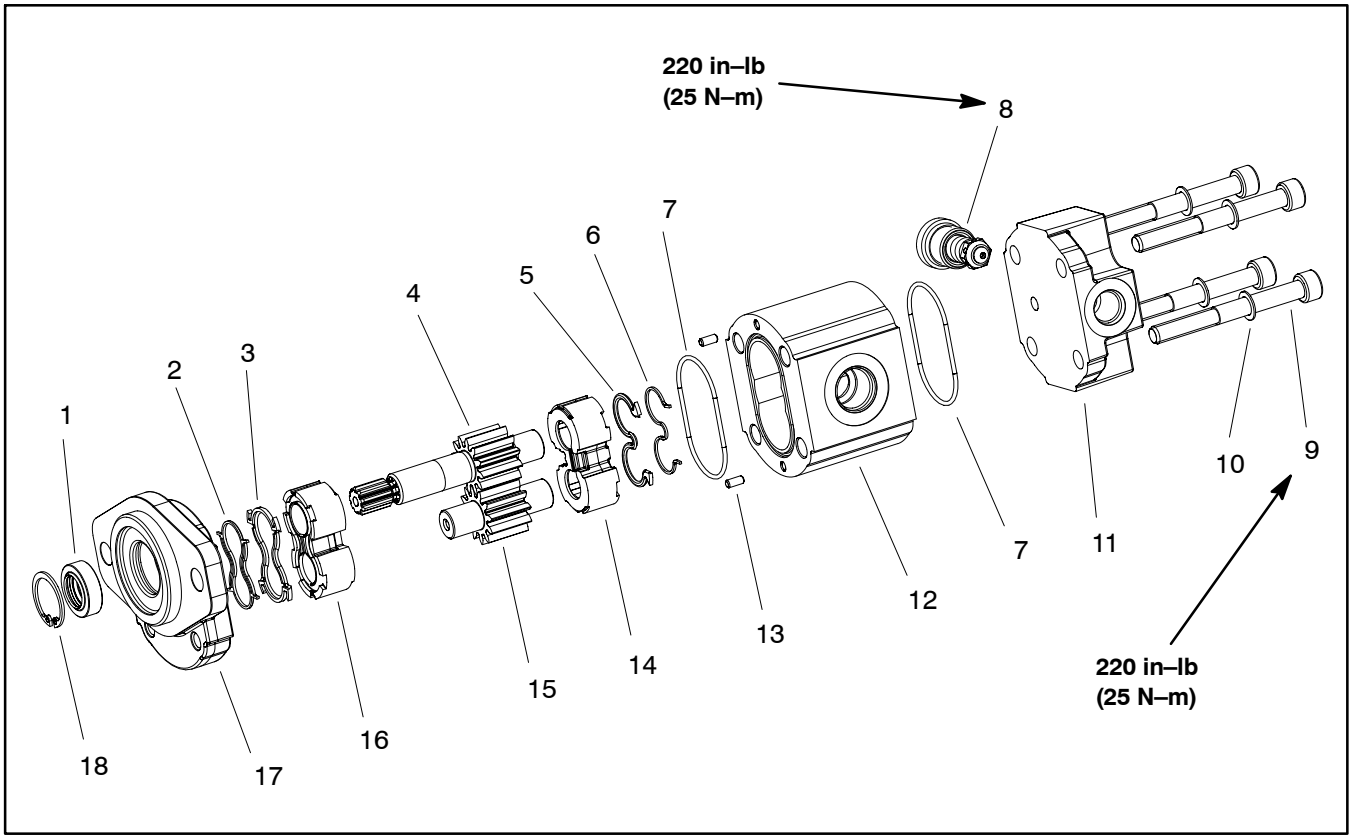

Figure 96

1. **Shaft seal**
2. **Front pressure seal**
3. **Front back–up ring**
4. **Drive gear**
5. **Rear back–up ring**
6. **Rear pressure seal**
7. **O–ring**
8. **Implement relief valve**
9. **Socket head screw (4 used)**
10. **Lock washer (4 used)**
11. **Back plate**
12. **Body**
13. **Dowel pin**
14. **Rear bearing block**
15. **Idler gear**
16. **Front bearing block**
17. **Front plate**
18. **Retaining ring**

Disassembly (Fig. 96)

1. Install clean plugs in pump ports and clean the outside of the pump thoroughly. After cleaning, remove plugs and drain any oil out of the pump.

2. Use a marker to make a “V” across the front plate, body and back plate for assembly purposes (Fig. 97).

IMPORTANT: When clamping the pump in a vise, clamp only on mounting flange. DO NOT clamp pump body in a vise.

3. Clamp mounting flange of pump in a vise with the shaft end down.

4. Loosen four (4) socket head screws that secure the back plate.

5. Remove pump from the vise. Remove socket head screws and lock washers.

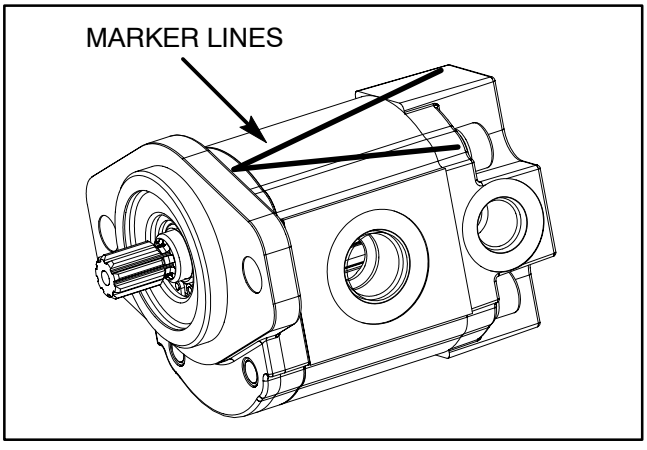

Figure 97

6. Remove front plate from the body, then remove back plate. Locate and remove dowel pins from body.

IMPORTANT: Mark the relative positions of the gear teeth and bearing blocks so they can be assembled in the same position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.

7. Place pump on its side and push on the rear bearing block to remove bearing blocks and gear set from the pump body.

NOTE: Pressure seals and back–up rings fit in grooves machined into bearing blocks. O–rings fit in grooves machined in the pump body.

8. Carefully remove and discard O–rings, pressure seals and back–up rings from pump body and bearing blocks. Do not cause any damage to the machined grooves during the removal process.

9. Turn front plate over, with seal side up and remove the retaining ring.

IMPORTANT: Make sure to not damage the counter bore when removing the shaft seal from the front plate.

10. Carefully remove shaft seal from the front plate.

11. If necessary, remove implement relief valve from back plate. Remove and discard sealing washers.

Inspection

CAUTION

Use eye protection such as goggles when using compressed air.

1. Clean all pump parts with solvent. Dry all parts with compressed air.

2. Inspect drive gear, idler gear and bearing blocks for the following. If damage is found, pump replacement is necessary.

A. Gear shafts should be free of rough surfaces and excessive wear at bushing points and sealing areas. Scoring, rough surfaces or wear on gear shafts indicates need for replacement.

B. Gear teeth should be free of excessive scoring and wear. Any broken or nicked gear teeth must be replaced.

C. Inspect gear face edge for sharpness. Sharp edges of gears will mill into bearing blocks and, thus, must be replaced.

D. Bearing areas of bearing blocks should not have excessive wear or scoring.

E. Face of bearing blocks that are in contact with gears should be free of wear, roughness or scoring.

3. Inspect front plate and back plate for damage or wear. Replace pump if plates are damaged or worn.

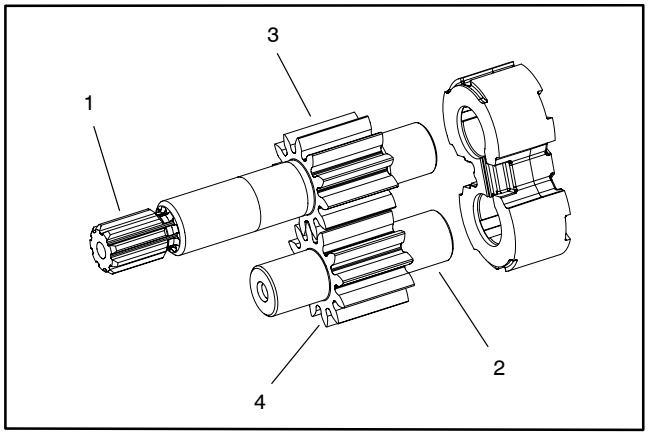

Figure 98

1. **Gear shaft spline**
2. **Gear shaft**
3. **Gear teeth**
4. **Gear face edge**

Assembly (Fig. 96)

NOTE: When assembling the pump, check the V–shaped marker line made during disassembly to make sure components are properly aligned.

1. Lubricate new O–rings, pressure seals and back–up gaskets with a thin coat of petroleum jelly. Lubricate all internal pump parts freely with clean hydraulic oil.

2. Install new shaft seal in front plate. Seal should be pressed into place until it reaches the bottom of the bore.

3. Install retaining ring into the groove of the front plate.

4. Install lubricated O–rings to the body.

5. Install lubricated pressure seals into the machined grooves of the bearing blocks and follow by carefully placing the back–up rings into the grooves.

6. Lubricate gear faces and bearing surfaces of drive gear, idler gear and bearing blocks with clean hydraulic oil. Carefully assemble bearing blocks and gears noting identification marks made during disassembly.

7. Position the pump body on its side. Carefully slide bearing block and gear assembly into the body cavity using identification marks made during disassembly.

8. Remove any excess lubrication from mating surfaces of body, back plate and front plate. Make sure that these surfaces are clean and dry.

9. Install dowel pins in body.

IMPORTANT: Do not dislodge O–rings, pressure seals or back–up rings during final assembly.

10. Gently slide the back plate onto the assembly using marker lines for proper location. Firm hand pressure should be sufficient to engage the dowel pins.

11. Place thin sleeve or tape on pump shaft splines to prevent seal damage.

12. Position the pump with back plate downwards. Carefully slide the front plate onto the assembly using marker lines for proper location. Take care to not damage the seal during front plate installation. Remove sleeve or tape from shaft splines.

13. Install the four (4) socket head screws with lock washers and hand tighten.

IMPORTANT: When clamping the pump in a vise, clamp only on mounting flange. DO NOT clamp pump body in a vise.

14. Clamp mounting flange of pump in a vise with the shaft end down.

15. Alternately torque the socket head screws **220 in–lb (25 N–m)**.

16. If implement relief valve was removed from back plate, install relief valve. Torque relief valve **220 in–lb (25 N–m)**.

17. Put a small amount of hydraulic oil in inlet port of pump and rotate input shaft one revolution. Place coupler on input shaft and use pliers on coupler to rotate pump shaft. If input shaft binds, disassemble pump and repeat assembly process.

18. Remove pump from vise.

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Lift Control Valve

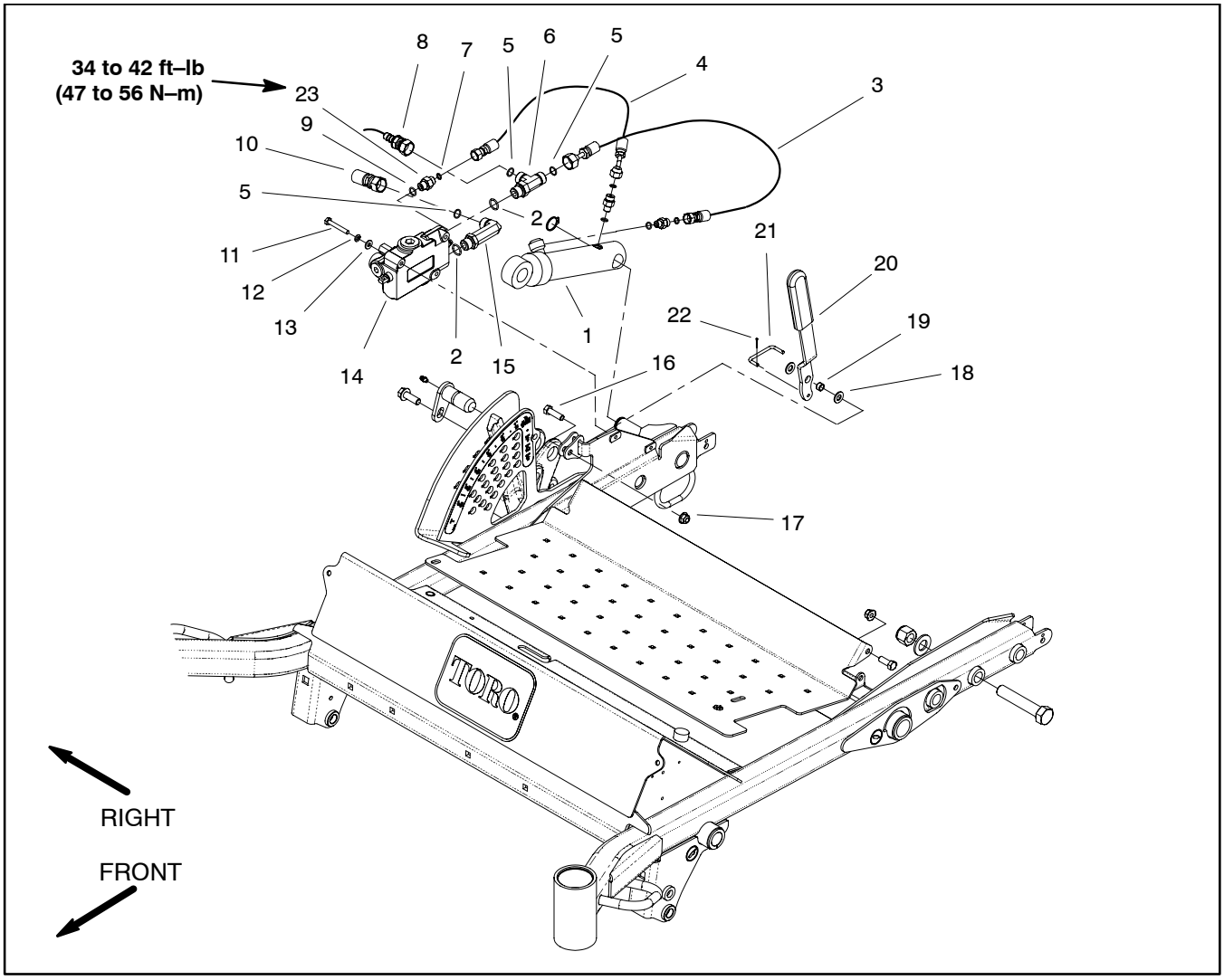

Figure 99

1. **Lift cylinder**
2. **O–ring**
3. **Hydraulic hose**
4. **Hydraulic hose**
5. **O–ring**
6. **Hydraulic tee fitting**
7. **O–ring**
8. **Hydraulic hose (to oil cooler)**
9. **O–ring**
10. **Hydraulic hose (from gear pump)**
11. **Cap screw (2 used)**
12. **Lock washer (2 used)**
13. **Flat washer (2 used)**
14. **Lift control valve**
15. **Hydraulic fitting**
16. **Cap screw**
17. **Flange nut**
18. **Washer (2 used)**
19. **Spacer**
20. **Lift lever assembly**
21. **Valve link**
22. **Cotter pin (2 used)**
23. **Hydraulic fitting**

Removal (Fig. 99)

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Thoroughly clean hydraulic hose ends and fittings on lift control valve to prevent hydraulic system contamination.

3. Label all hydraulic hoses and fittings for assembly purposes.

4. Disconnect hydraulic hoses connected to the hydraulic fittings on the lift control valve. Allow hoses to drain into a suitable container. Install clean plugs in hose openings to prevent system contamination.

5. Remove cotter pin that secures lift lever valve link to control valve spool (Fig. 100). Slide link from spool.

6. Support the control valve to prevent it from falling during removal.

7. Remove two (2) cap screws, lock washers and flat washers that secure lift control valve to machine (Fig. 100). Remove control valve.

8. If necessary, remove hydraulic fittings from lift control valve. Note orientation of fittings for assembly purposes. Remove and discard O–rings from fittings.

Installation (Fig. 99)

1. If hydraulic fittings were removed from lift control valve, lubricate and install new O–rings to fittings. Install fittings into valve ports (see Hydraulic Fitting Installation in the General Information section of this chapter). Orientate fittings as noted during removal.

2. Position lift control valve to machine frame and secure with two (2) cap screws, lock washers and flat washers (Fig. 100).

3. Attach lift lever valve link to control valve spool and secure with cotter pin (Fig. 100).

4. Remove plugs that were installed in hydraulic hoses during the removal procedure. Attach hydraulic hoses to fittings on lift control valve using labels placed during removal (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Make sure hydraulic tank is full. Add correct oil if necessary.

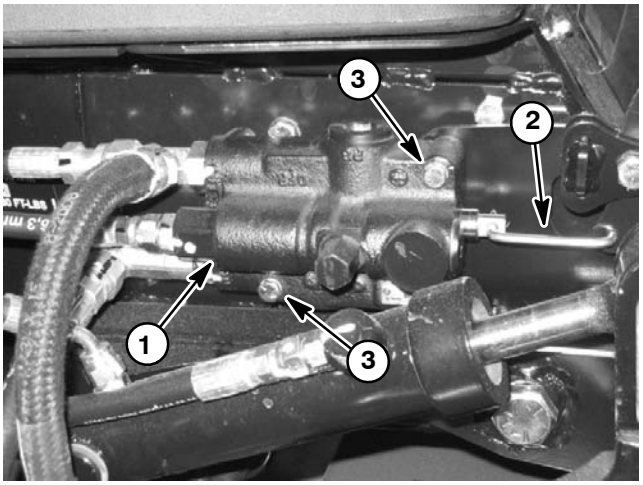

Figure 100

1. **Lift control valve**
2. **Lift lever valve link**
3. **Cap screw**

Lift Control Valve Service

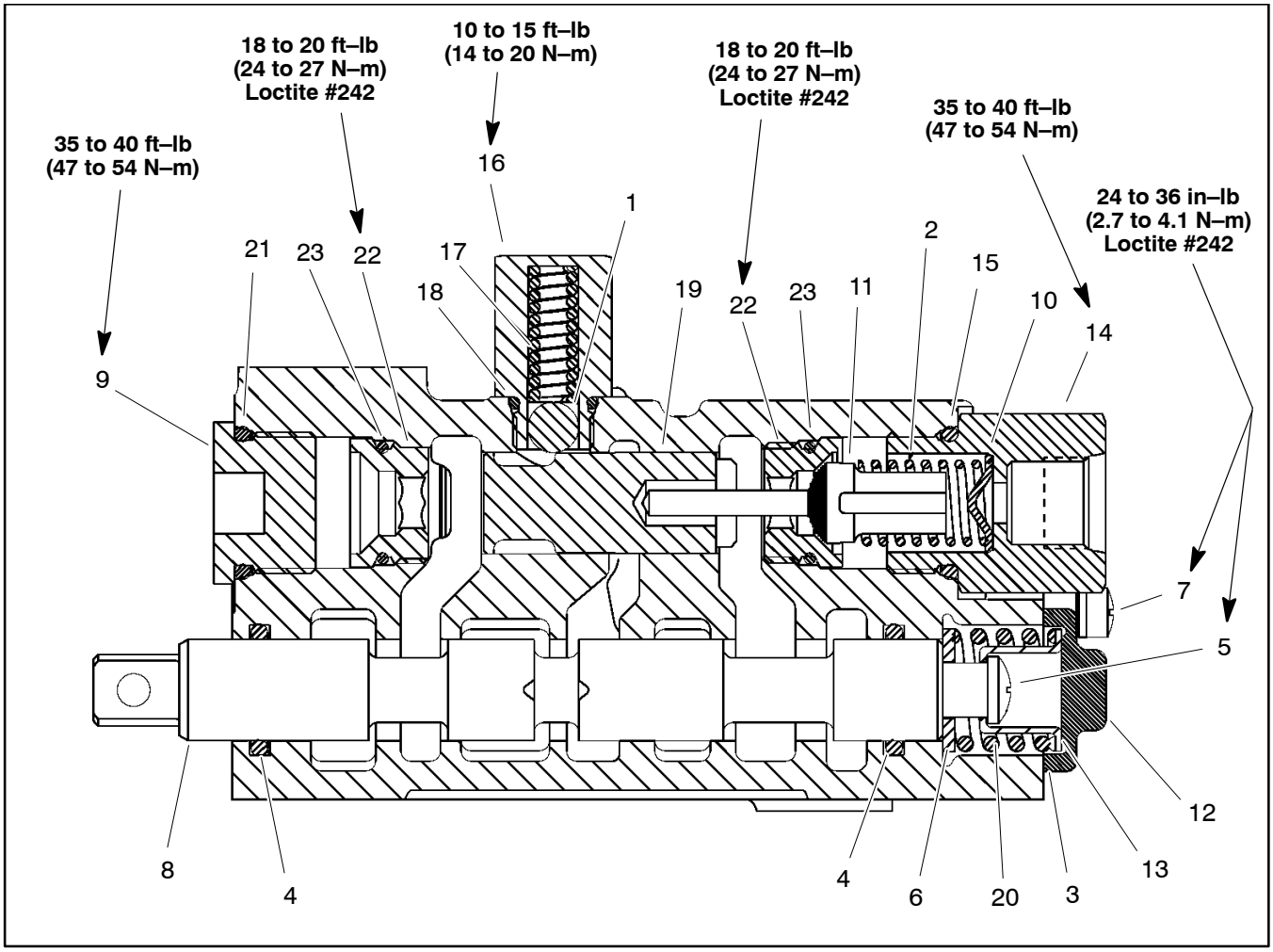

Figure 101

1. Detent ball
2. Spring
3. Gasket
4. O–ring
5. Screw
6. Washer
7. Screw and lock washer (2 used)
8. Spool
9. Plug
10. Poppet stop
11. Poppet
12. End cap
13. Spacer
14. Adapter plug
15. O–ring
16. Detent plug
17. Spring
18. O–ring
19. Detent plunger
20. Spring
21. O–ring
22. Lockout seat
23. O–ring

Disassembly (Fig. 101)

1. Plug all ports and clean the outside of control valve thoroughly.

2. Remove two (2) screws with lock washers (item 7) that secure end cap (item 12) to control valve. Remove end cap.

3. Retain spool to prevent it from turning. Remove screw (item 5), spacer (item 13), spring (item 20) and washer (item 6) from control valve.

4. Carefully slide spool (item 8) from housing bore.

5. Carefully remove O–rings (item 4) from spool bore. Take care to not damage spool bore or O–ring cavities during O–ring removal.

6. Remove detent plug (item 16), O–ring (item 18), spring (item 17) and detent ball (item 1).

7. Remove plug (item 9) with O–ring (item 21) and lock-out seat (item 22) with O–ring (item 23) from valve body.

8. Remove adapter plug (item 14) with O–ring (item 15), poppet stop (item 10), spring (item 2) and poppet (item 11) from control valve body.

9. Remove lockout seat (item 22) with O–ring (item 23) from control valve body. Remove detent plunger (item 19).

10. If necessary, remove plug from control valve (Fig. 102). **Note:** If machine is equipped with optional rear lift kit, a fitting and sleeve will be installed in place of plug.

Inspection

1. Inspect spool and spool bore for wear. If wear is excessive, replace lift control valve assembly.

2. Inspect all springs and replace if damaged or broken.

3. Inspect detent plunger, detent ball and poppet for wear. Replace as necessary.

4. Inspect lockout seats for wear or damage. Replace as necessary.

5. Inspect control valve housing threads and O–ring sealing surfaces. Replace as necessary.

6. Inspect threads and O–ring sealing surfaces on plugs. Replace as necessary.

Assembly (Fig. 101)

IMPORTANT: Do not wipe parts with dry paper towels or rags. Lint may cause damage to the hydraulic system.

CAUTION

Use eye protection such as goggles when using compressed air.

1. Clean all control valve components with clean solvent and blow dry with compressed air.

2. Replace all removed O–rings. Lightly lubricate new O–rings with clean hydraulic oil before assembly.

3. Carefully install new O–rings into control valve spool bore taking care to not damage O–rings during installation.

4. Lubricate spool liberally with clean hydraulic fluid and carefully install into control valve bore.

5. Coat spacer (item 13), spring (item 20) and washer (item 6) liberally with MPG–2 (or equivalent) grease. Apply Loctite #242 (or equivalent) to threads of screw (item 5). Install washer, spring and spacer into valve and secure with screw. Retain spool to prevent it from turning and torque screw from **24 to 36 in–lb (2.7 to 4.1 N–m)**.

6. Apply Loctite #242 (or equivalent) to threads of screws (item 7).

7. Position gasket (item 3) and end cap (item 12) to control valve. Secure end cap to valve with two (2) screws with lock washers (item 7). Torque screws from **24 to 36 in–lb (2.7 to 4.1 N–m)**.

8. Lubricate detent plunger (item 19) with clean hydraulic oil and slide into control valve bore.

9. Install new O–rings (items 23) to lockout seats (items 22). Apply Loctite #242 (or equivalent) to threads of lockout seats. Install seats into control valve. Torque seats from **18 to 20 ft–lb (24 to 27 N–m)**.

10. Lubricate poppet (item 11), spring (item 2) and poppet stop (item 10) liberally with clean hydraulic fluid and install into control valve bore. Make sure that stop extends into spring coils after installation.

11. Install adapter plug (item 14) with new O–ring (item 15) and plug (item 9) with new O–ring (item 21) into control valve. Torque plugs from **35 to 40 ft–lb (47 to 54 N–m)**.

12. Install new O–ring to detent plug (item 16). Lubricate detent ball (item 1) and spring (item 17) with clean hydraulic fluid and install into detent plug.

13. Install detent plug assembly to control valve. Torque plug from **10 to 15 ft–lb (14 to 20 N–m)**.

14. If plug was removed, carefully thread plug into control valve housing (Fig. 102). Torque plug from **60 to 70 ft–lb (81 to 94 N–m)**.

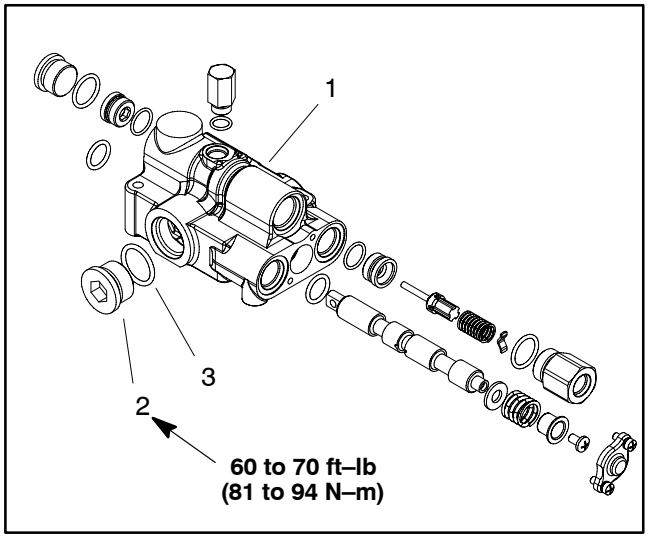

Figure 102

1. **Lift control valve**
2. **Plug**
3. **O–ring**

Polar Trac™ Hydraulic Control Valve

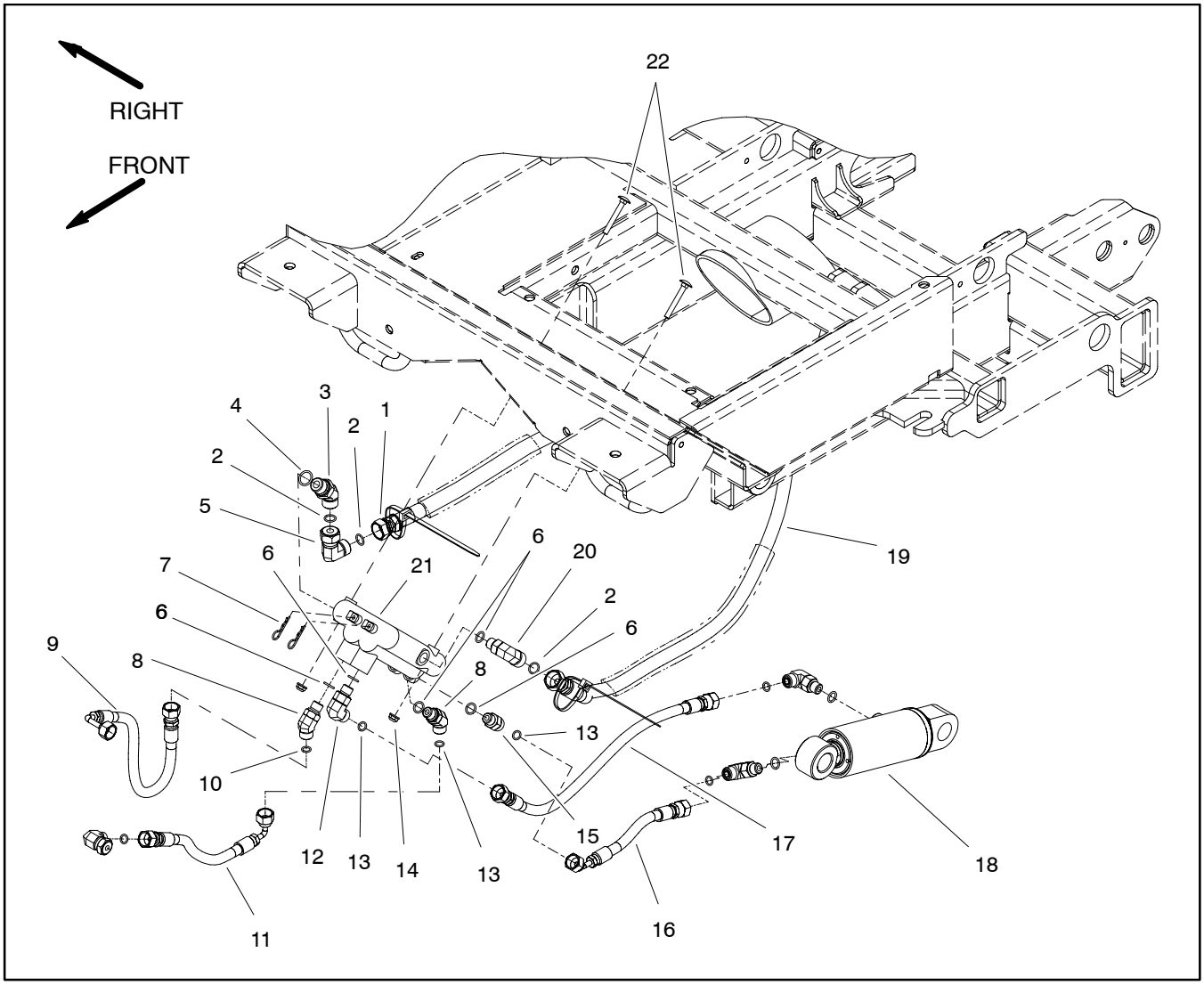

Figure 103

1. **Hydraulic hose**
2. **O–ring**
3. **45º hydraulic fitting**
4. **O–ring**
5. **90º hydraulic fitting**
6. **O–ring**
7. **Hair pin (2 used)**
8. **45º hydraulic fitting**
9. **Hydraulic hose**
10. **O–ring**
11. **Hydraulic hose**
12. **90º hydraulic fitting**
13. **O–ring**
14. **Flange nut (2 used)**
15. **Hydraulic fitting**
16. **Hydraulic hose**
17. **Hydraulic hose**
18. **Hydraulic cylinder**
19. **Hydraulic hose**
20. **90º hydraulic fitting**
21. **Hydraulic control valve**
22. **Carriage screw (2 used)**

Removal (Fig. 103)

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

1. Park machine on a level surface, lower implement, stop engine, engage parking brake and remove key from the ignition switch.

2. Thoroughly clean hydraulic hose ends and fittings on control valve to prevent hydraulic system contamination.

3. Label all hydraulic hoses and fittings for assembly purposes.

4. Disconnect hydraulic hoses connected to the hydraulic fittings on the control valve. Allow hoses to drain into a suitable container. Install clean plugs in hose openings to prevent system contamination.

5. Remove hair pins that secure lever valve links to control valve spools (Fig. 104). Slide links from spools.

6. Support the control valve to prevent it from falling during removal.

7. Remove two (2) carriage screws and flange nuts that secure control valve to machine. Remove control valve from machine.

8. If necessary, remove hydraulic fittings from control valve. Note orientation of fittings for assembly purposes. Remove and discard O–rings from fittings.

Installation (Fig. 103)

1. If hydraulic fittings were removed from control valve, lubricate and install new O–rings to fittings. Install fittings into valve ports (see Hydraulic Fitting Installation in the General Information section of this chapter). Orientate fittings as noted during removal.

2. Position control valve to machine frame and secure with two (2) carriage screws and flange nuts.

3. Attach lift lever valve links to control valve spools and secure with hair pins (Fig. 104).

4. Remove plugs that were installed in hydraulic hoses during the removal procedure. Attach hydraulic hoses to fittings on control valve using labels placed during removal (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Make sure hydraulic tank is full. Add correct oil if necessary.

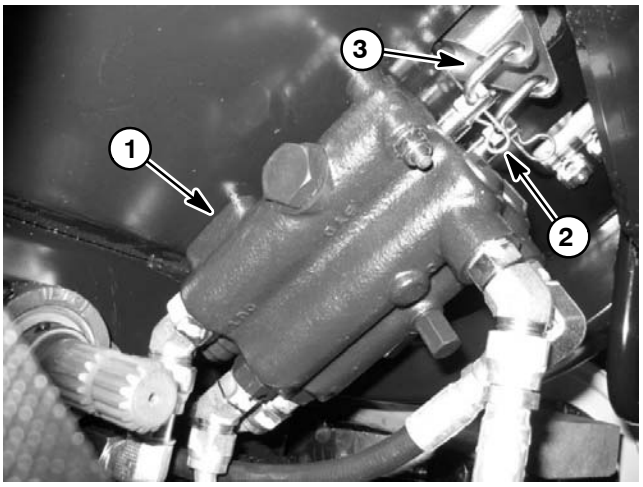

Figure 104

1. **Control valve**
2. **Hair pin**
3. **Lever valve link**

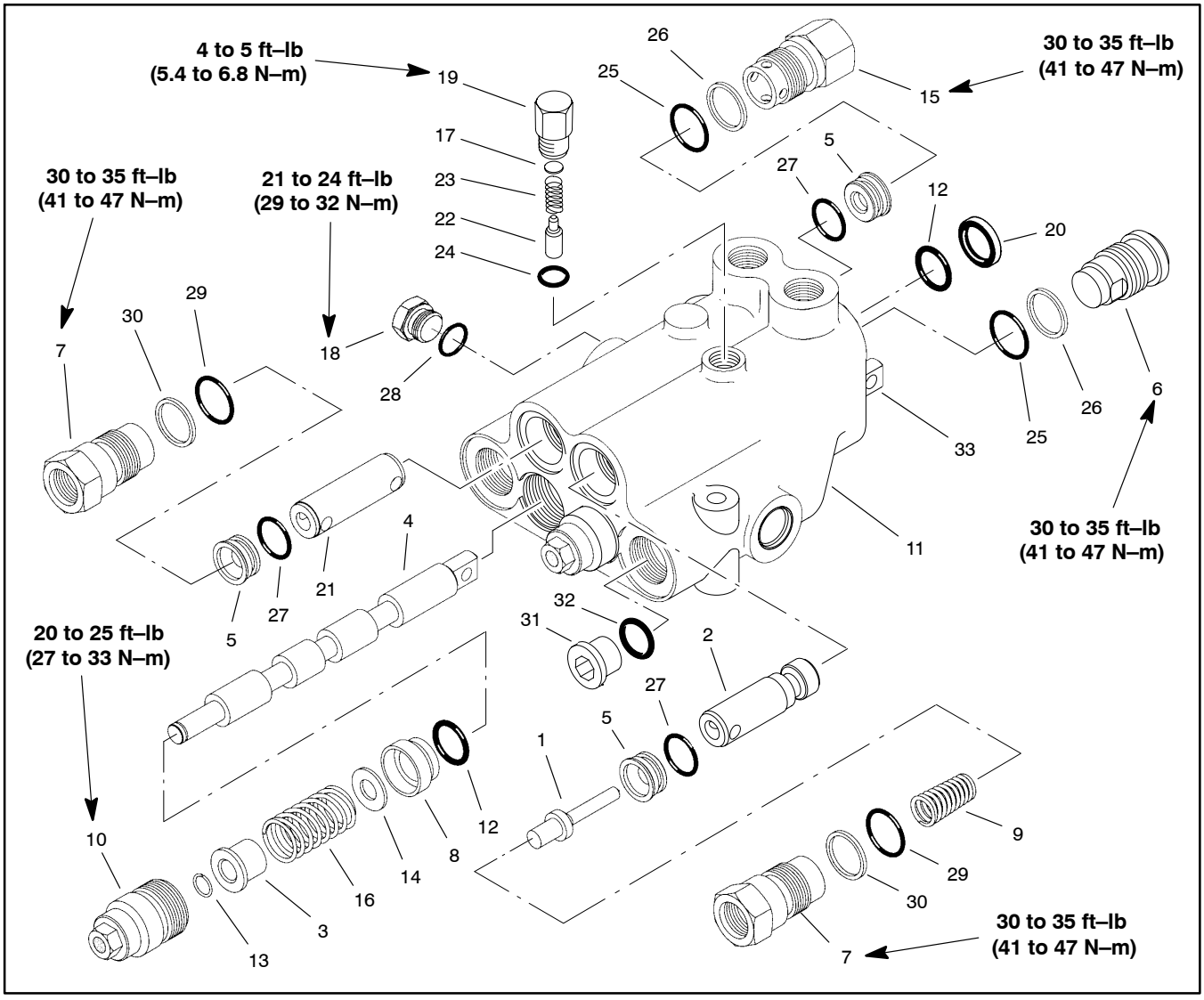

Figure 105

1. Check poppet
2. Detent plunger
3. Spacer
4. Spool
5. Seat (3 used)
6. Solid plug
7. Seat retaining plug (2 used)
8. Bushing
9. Check spring
10. Spool cap (2 used)
11. Valve body
12. O–ring
13. Retaining ring
14. Washer
15. Seat retaining plug
16. Spool spring
17. Disc
18. Plug
19. Detent plug
20. Wiper seal
21. Plunger
22. Detent plunger
23. Detent spring
24. O–ring
25. O–ring
26. Back–up washer
27. O–ring
28. O–ring
29. O–ring
30. Back–up washer
31. Plug
32. O–ring
33. Spool

Disassembly (Fig. 105)

1. Plug all ports and clean the outside of the valve thoroughly.

IMPORTANT: Match–mark spools to their associated bores before disassembly. Spools must be reinstalled to the bore from which they were removed.

2. Remove both spool caps (item 10) and slide the spool assemblies from their bores.

3. Remove O–ring (item 12) and bushing (item 8) from each spool assembly.

4. Remove wiper seals (item 20) and O–rings (item 12) from the spool bore ends that are opposite the spool caps.

NOTE: Disassemble spool assemblies only if the retaining ring (item 13), spacer (item 3), spool spring (item 16) or washer (item 14) need replacing.

5. Remove seat retaining plugs (items 7 and 15), back–up washers, O–rings and check spring (item 9) from the valve body.

6. Remove check poppet (item 1), seats (item 5), O–rings (item 27) and plungers (items 2 and 21) from the valve body.

7. Remove solid plug (item 6), back–up washer and O–ring from the opposite end of the plunger.

8. Remove detent plug (item 19) and O–ring from the valve body. Remove disc, spring and detent plunger from the body.

Inspection

1. Inspect spools and spool bores for wear. If wear is excessive, replace control valve with new one.

2. Inspect springs and replace as necessary.

3. Inspect plunger and detent plunger for wear. Replace as necessary.

4. Inspect caps and plugs for damaged threads and inspect O–ring sealing surfaces. Replace as necessary.

Assembly (Fig. 105)

IMPORTANT: Do not wipe control valve parts with dry paper towels or rags. Lint may cause damage to the hydraulic system.

CAUTION

Use eye protection such as goggles when using compressed air.

1. Clean all metal parts with solvent and blow dry with compressed air.

2. Replace check poppet (item 1), O–rings and back–up washers with new ones.

3. Install new O–rings (item 12) into the valve body.

4. If a spool was disassembled, install washer (item 14), spool spring (item 16), spacer (item 3) and retaining ring (item 13) to the spool.

5. Slide bushings (item 8) and new O–rings (item 12) over the spools.

6. Lubricate spools liberally with clean hydraulic fluid and carefully install into their proper bore.

7. Install spool caps (item 10) into valve body. Torque caps from **20 to 25 ft–lb (27 to 33 N–m)**.

8. Lubricate both plungers (items 2 and 21) liberally with clean hydraulic fluid and install into their proper bore.

9. Install new O–rings, seats (item 5), check poppet (item 1) and check spring (item 9) into the plunger bores.

10. Install O–rings, back–up washers and seat retaining plugs (items 7 and 15) into their plunger bores. Torque plugs from **30 to 35 ft–lb (41 to 47 N–m)**.

11. Install new O–ring, back–up washer and solid plug (item 6) into the bore with the detent plunger. Torque plug from **30 to 35 ft–lb (41 to 47 N–m)**.

12. Lubricate detent plunger (item 22), spring and disc liberally with clean hydraulic fluid and install into valve body bore.

13. Install O–ring and detent plug (item 19) into valve body. Torque plug from **4 to 5 ft–lb (5.4 to 6.8 N–m)**.

Lift Cylinder

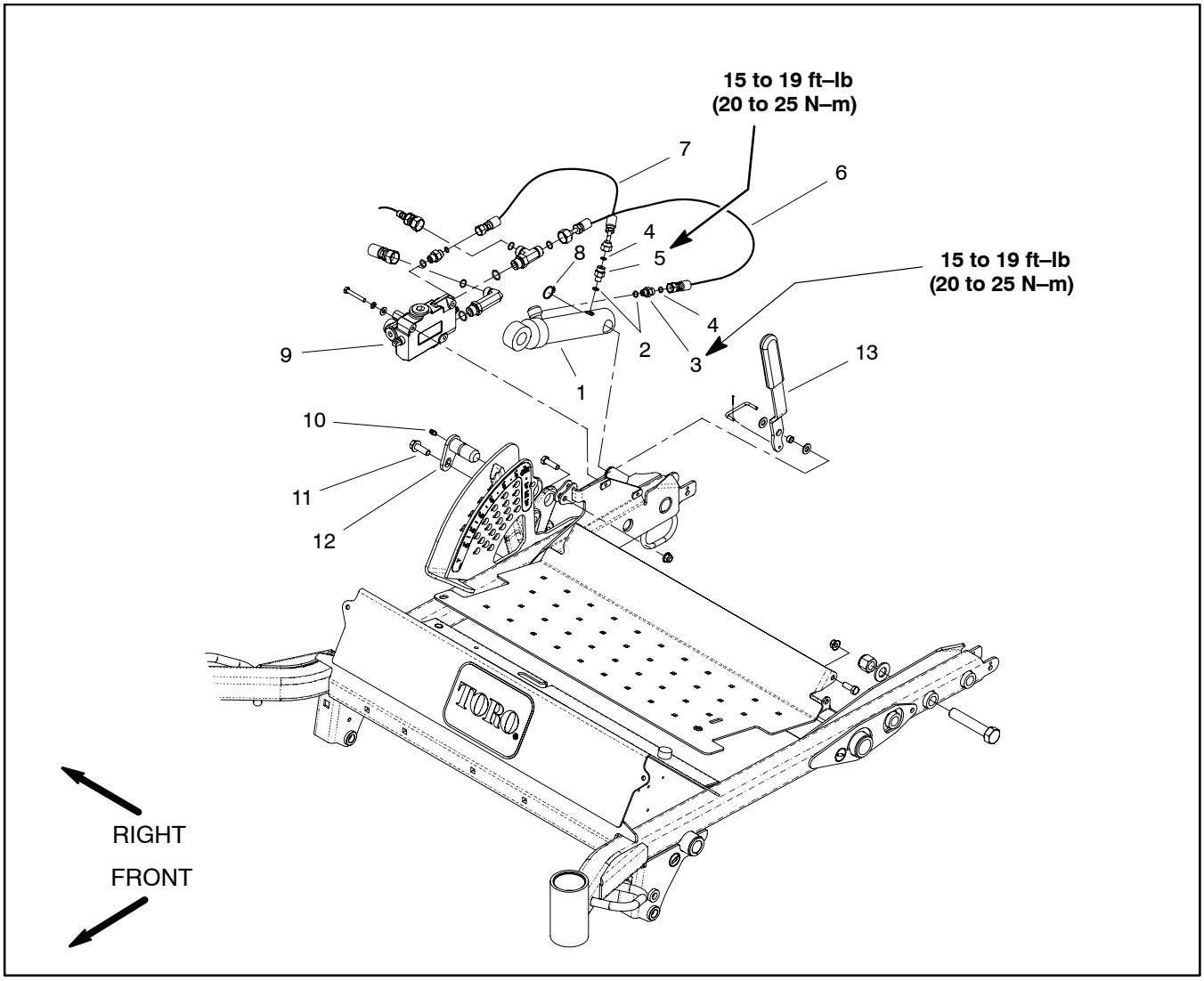

Figure 106

1. **Lift cylinder**
2. **O–ring**
3. **Hydraulic fitting**
4. **O–ring**
5. **Hydraulic fitting (0.052 orifice)**
6. **Hydraulic hose**
7. **Hydraulic hose**
8. **Retaining ring**
9. **Lift control valve**
10. **Grease fitting**
11. **Flange head screw**
12. **Pivot pin**
13. **Lift lever**

Removal (Fig. 106)

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Thoroughly clean hydraulic hose ends and fittings on lift cylinder to prevent hydraulic system contamination.

3. Label hydraulic hoses for assembly purposes. Also, label orientation of hydraulic hose at barrel end of lift cylinder to allow correct assembly.

4. Disconnect hydraulic hoses connected to the hydraulic fittings on the lift cylinder. Install clean plugs in hose openings to prevent system contamination.

5. Remove retaining ring that secures lift cylinder barrel end to pin on carrier frame.

6. Remove flange head screw and pivot pin that secure lift cylinder rod end to RH lift arm (Fig. 107).

7. Remove lift cylinder from machine.

8. If necessary, remove hydraulic fittings from lift cylinder. Remove and discard O–rings from fittings. Note that fitting on barrel end of cylinder is an orifice fitting that is different than fitting on rod end of cylinder.

Installation (Fig. 106)

1. If hydraulic fittings were removed from lift cylinder, lubricate and install new O–rings to fittings. Install fittings into lift cylinder ports and torque fittings from **15 to 19 ft–lb (20 to 25 N–m)**. Make sure that fitting on barrel end of cylinder is the orifice fitting.

2. Position lift cylinder to the machine.

3. Secure cylinder barrel end to pin on carrier frame with retaining ring.

4. Secure cylinder rod end to RH lift arm with pivot pin and flange head screw (Fig. 107).

5. Remove plugs that were installed in hydraulic hoses during the removal procedure. Correctly connect hydraulic hoses to lift cylinder fittings using labels placed during lift cylinder removal (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Lubricate grease fittings on lift cylinder and pivot pin.

7. Make sure hydraulic tank is full. Add correct oil if necessary.

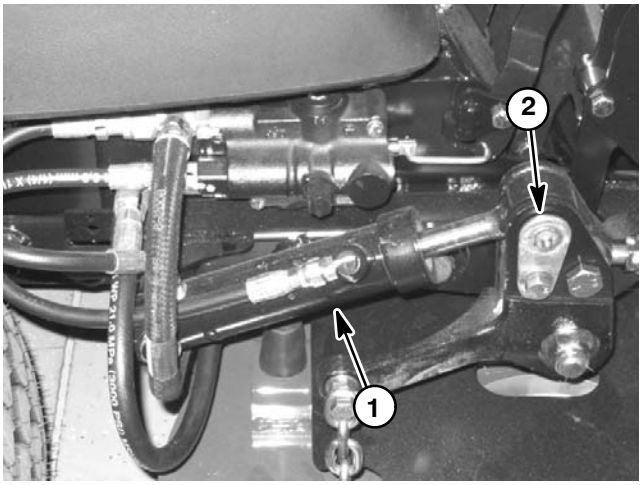

Figure 107

1. **Lift cylinder**
2. **Pivot pin**

Lift Cylinder Service

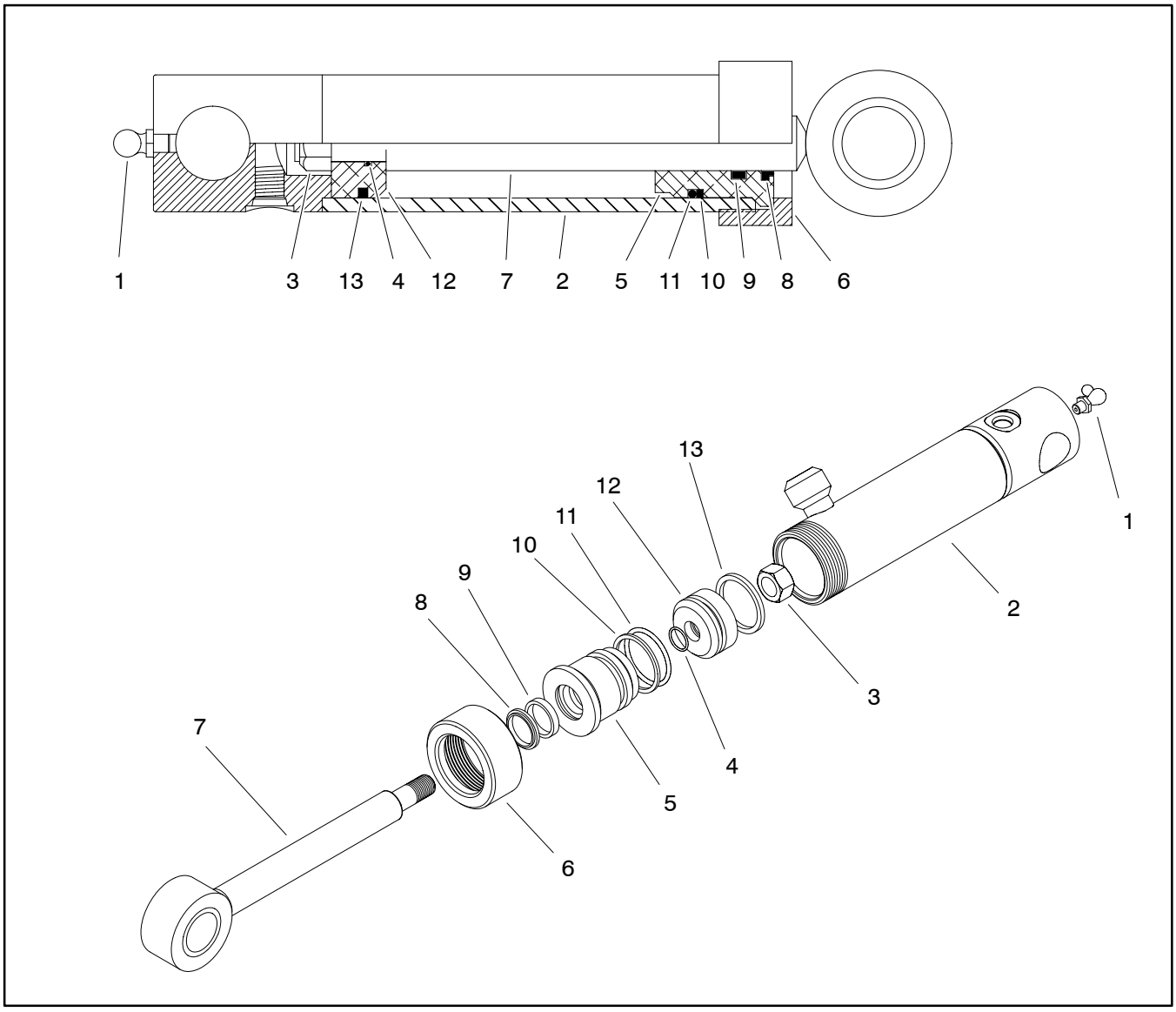

Figure 108

1. **Grease fitting**
2. **Barrel**
3. **Nut**
4. **O–ring**
5. **Head**
6. **Collar**
7. **Shaft**
8. **Dust seal**
9. **Rod seal**
10. **Back–up ring**
11. **O–ring**
12. **Piston**
13. **Piston seal**

Disassembly (Fig. 108)

1. Remove oil from lift cylinder into a drain pan by slowly pumping the cylinder shaft. Plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the clevis ONLY.

2. Mount lift cylinder in a vise. Use of a vise with soft jaws is recommended.

3. Carefully remove collar with a pipe wrench.

4. Remove plugs from ports. Extract shaft, head and piston by carefully twisting and pulling on the shaft.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Clamp on the clevis ONLY.

5. Mount shaft securely in a vise by clamping on the clevis of the shaft. Remove nut and piston from the shaft. Slide head off the shaft.

6. Remove piston seal and O–ring from the piston. Remove O–ring, back–up ring, rod seal and dust seal from the head.

Assembly (Fig. 108)

1. Make sure all parts are clean before reassembly.

2. Coat new O–rings, piston seal, rod seal, back–up ring and dust seal with clean hydraulic oil.

   A. Install piston seal and O–ring to the piston.

   B. Install dust seal, O–ring, back–up ring and dust seal to the head.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Clamp on the clevis ONLY.

3. Mount shaft securely in a vise by clamping on the clevis of the shaft.

   A. Coat shaft with clean hydraulic oil.

   B. Slide head onto the shaft taking care to not damage the seals. Install rod seal onto shaft and into head.

   C. Install piston onto the shaft and secure with nut.

   D. Remove shaft from the vise.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the clevis ONLY.

4. Mount barrel in a vise.

5. Coat all internal parts with a light coat of clean hydraulic oil. Carefully slide piston, shaft and head assembly into the barrel being careful not to damage the seals.

6. Install collar using a pipe wrench to secure head in barrel.

Polar Trac™ Lift Cylinder

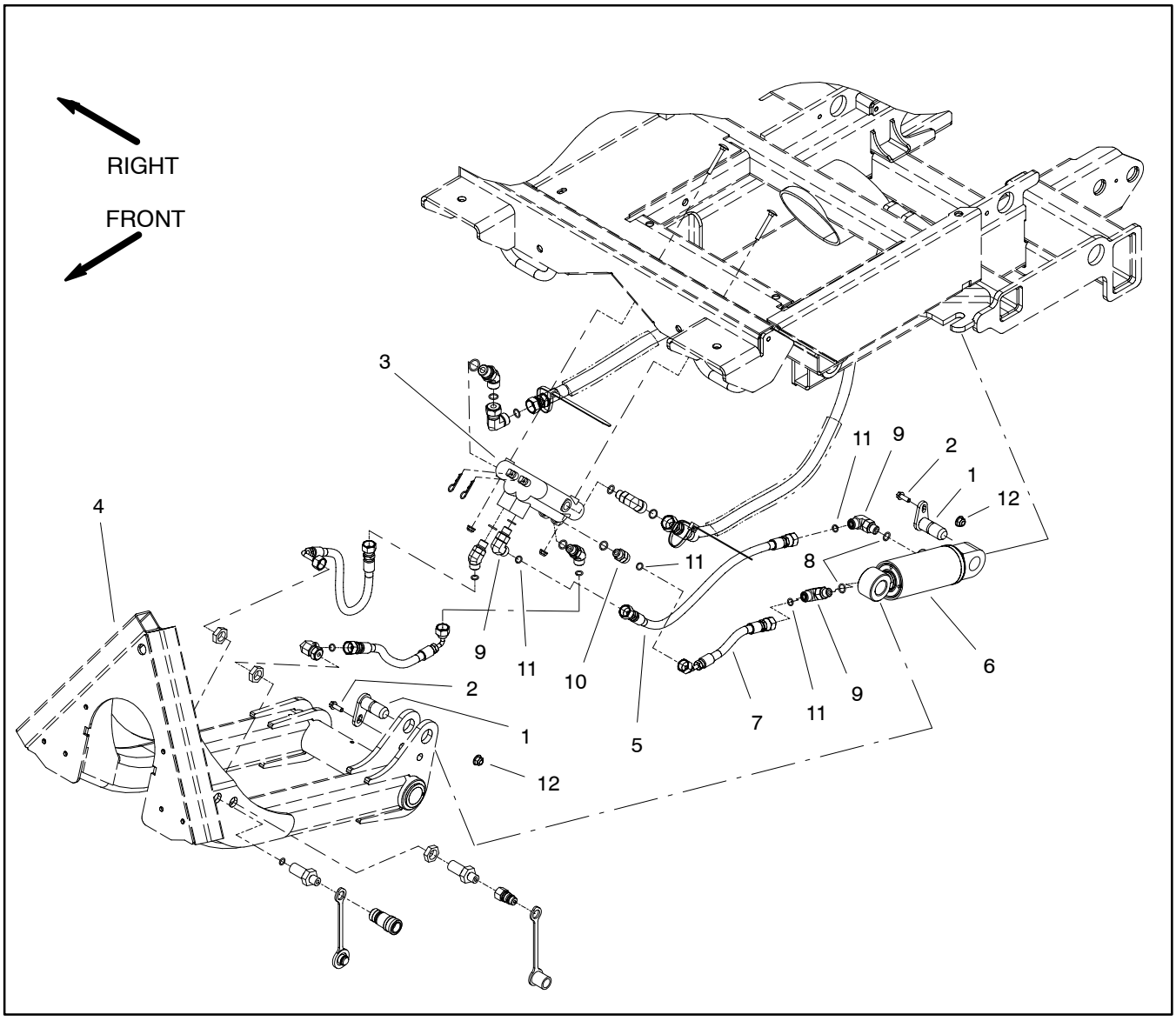

Figure 109

1. **Pivot pin**
2. **Screw**
3. **Hydraulic control valve**
4. **Lift arm**
5. **Hydraulic hose**
6. **Hydraulic cylinder**
7. **Hydraulic hose**
8. **O–ring**
9. **90º hydraulic fitting**
10. **Hydraulic fitting**
11. **O–ring**
12. **Lock nut**

Removal (Fig. 109)

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

1. Park machine on a level surface, lower implement, stop engine, engage parking brake and remove key from the ignition switch.

2. Thoroughly clean hydraulic hose ends and fittings on lift cylinder to prevent hydraulic system contamination.

3. Label hydraulic hoses for assembly purposes.

4. Disconnect hydraulic hoses connected to the hydraulic fittings on the lift cylinder. Install clean plugs in hose openings to prevent system contamination.

5. Remove lock nut, screw and pivot pin that secure lift cylinder barrel end to carrier frame.

6. Remove lock nut, screw and pivot pin that secure lift cylinder rod end to lift arm.

7. Remove lift cylinder from machine.

8. If necessary, remove hydraulic fittings from lift cylinder. Note orientation of fittings for assembly purposes. Remove and discard O–rings from fittings.

Installation (Fig. 109)

1. If hydraulic fittings were removed from lift cylinder, lubricate and install new O–rings to fittings. Install fittings into lift cylinder ports (see Hydraulic Fitting Installation in the General Information section of this chapter). Orientate fittings as noted during removal.

2. Position lift cylinder to the machine.

3. Secure cylinder barrel end to carrier frame with pivot pin, screw and lock nut.

4. Secure cylinder rod end to lift arm with pivot pin, screw and lock nut.

5. Remove plugs that were installed in hydraulic hoses during the removal procedure. Correctly connect hydraulic hoses to lift cylinder fittings using labels placed during lift cylinder removal (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Lubricate grease fittings on cylinder pivot pins.

7. Make sure hydraulic tank is full. Add correct oil if necessary.

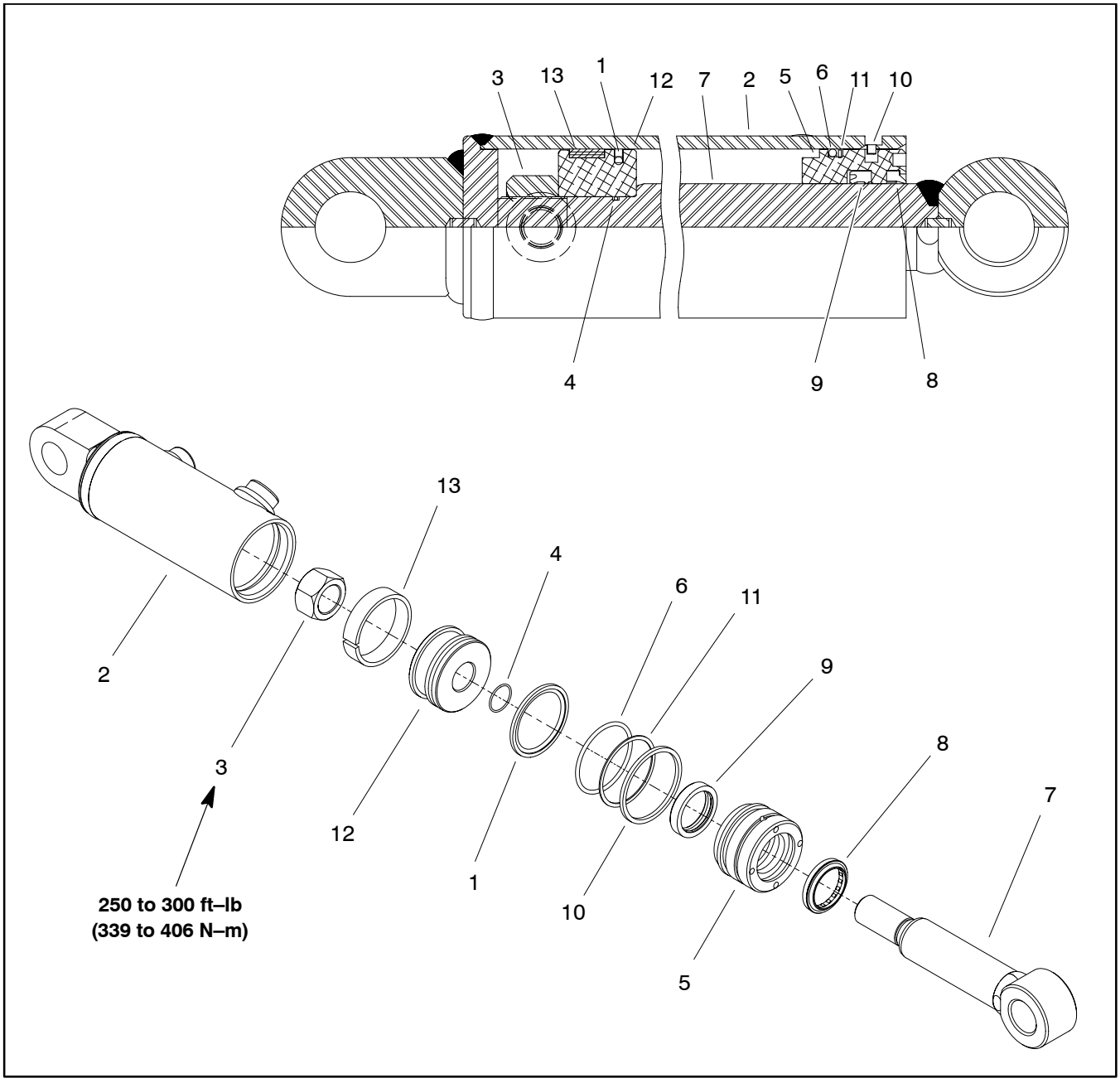

Figure 110

1. Cap seal
2. Barrel
3. Lock nut
4. O–ring
5. Head
6. O–ring
7. Rod
8. Wiper
9. Seal
10. Retaining ring
11. Back–up ring
12. Piston
13. Wear ring

Disassembly (Fig. 110)

1. Remove oil from lift cylinder into a drain pan by slowly pumping the cylinder rod. Plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the lift cylinder into a vise; clamp on the clevis end of the barrel ONLY.

2. Mount lift cylinder securely in a vise by clamping on the clevis end of the barrel. Use of a vise with soft jaws is recommended.

3. Using a spanner wrench, rotate head clockwise until the edge of the retaining ring appears in the barrel opening. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening. Rotate the head counter–clockwise to remove retaining ring from barrel and head.

4. Remove plugs from ports. Extract shaft, head and piston by carefully twisting and pulling on the shaft.

IMPORTANT: Do not clamp vise jaws against the rod surface. Clamp on the clevis ONLY.

5. Mount rod securely in a vise by clamping on the clevis of the rod. Remove lock nut and piston from the rod. Carefully slide head off the shaft.

6. Taking care to not scratch or damage the piston, remove cap seal and O–ring from the piston. If necessary, remove wear ring from piston.

7. Taking care to not scratch or damage the head, remove O–ring, back–up ring, wiper and seal from the head.

Inspection

CAUTION

Use eye protection such as goggles when using compressed air.

1. Wash all lift cylinder components in solvent. Dry parts with compressed air.

2. Inspect internal surface of barrel for deep scratches, out–of–roundness and bending. Replace if worn or damaged.

3. Inspect head, shaft and piston for excessive pitting, scoring and wear. Replace any worn or damaged parts.

Assembly (Fig. 110)

1. Make sure all lift cylinder parts are clean before assembly.

2. Coat new O–rings, back–up ring and other seals with clean hydraulic oil.

   A. Carefully install cap seal and O–ring to the piston. Install wear ring on piston if removed.

   B. Carefully install back–up ring, O–ring, seal and wiper to the head.

IMPORTANT: Do not clamp vise jaws against the rod surface. Clamp on the clevis ONLY.

3. Mount rod securely in a vise by clamping on the clevis of the rod.

   A. Coat rod with clean hydraulic oil.

   B. Slide head onto the rod.

   C. Install piston onto the rod and secure with lock nut. Torque lock nut from **250 to 300 ft–lb (339 to 406 N–m)**.

   D. Remove shaft assembly from the vise.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the clevis end of the barrel ONLY.

4. Mount barrel securely in a vise by clamping on the clevis end of the barrel.

IMPORTANT: When installing the head into the barrel, pay careful attention to the retaining ring slot in the barrel to insure that the piston and head seals do not lodge in the slot.

5. Coat all internal parts with a light coat of clean hydraulic oil. Slide piston, shaft and head assembly into the barrel being careful not to damage the seals.

6. Secure head in barrel by installing retaining ring. Align retaining ring hole in the head with the access slot in the barrel. Insert the retaining ring hook into the hole and rotate head clockwise until the retaining ring is completely pulled into the barrel and the ring ends are covered.

Oil Cooler

Removal (Figs. 111 and 112)

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Raise hood and secure it in the raised position.

CAUTION

The radiator and oil cooler may be hot. To avoid possible burns, allow the engine and cooling systems to cool before working on the oil cooler.

3. Thoroughly clean hydraulic hose ends and oil cooler fittings to prevent hydraulic system contamination. Label hydraulic hoses for assembly purposes.

4. Remove hydraulic hoses from oil cooler. Install clean plugs in hose openings to prevent contamination. Remove and discard O–rings from oil cooler fittings.

5. Rotate clamp and tilt oil cooler from radiator frame. Slide left side of oil cooler from radiator frame by aligning roll pin in cooler mount with slot in radiator frame. Then, remove right side of cooler from radiator frame.

Inspection

1. Back flush oil cooler with cleaning solvent. Make sure all solvent is drained from the cooler.

CAUTION

Use eye protection such as goggles when using compressed air to dry oil cooler.

2. Dry inside of oil cooler using compressed air in the opposite direction of the oil flow.

3. Install clean plugs on oil cooler ports. Thoroughly clean exterior of cooler.

4. The oil cooler should be free of corrosion, cracked tubes or excessive pitting of tubes.

Installation (Figs. 111 and 112)

1. Install right side mount of oil cooler through hole in radiator frame. Then, slide left side cooler mount into radiator frame by aligning roll pin and slotted hole in radiator frame. Tilt cooler to radiator frame and secure with clamp.

2. Lubricate and place new O–rings in oil cooler ports. Remove plugs from hydraulic hoses. Connect hydraulic hoses to oil cooler using labels placed during removal (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

3. Make sure hydraulic tank is full. Add correct oil if necessary.

4. Lower and latch hood.

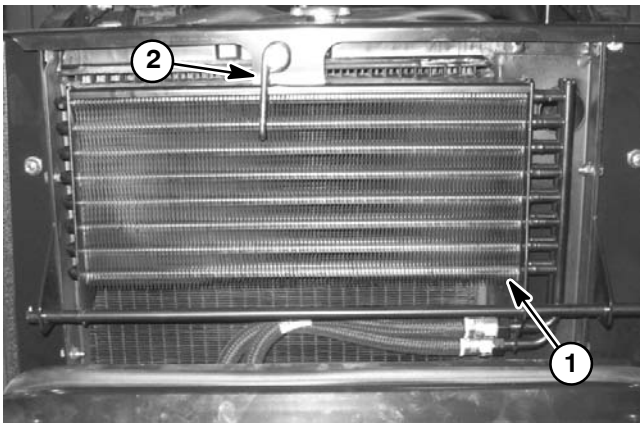

Figure 111

1. **Oil cooler**
2. **Clamp**

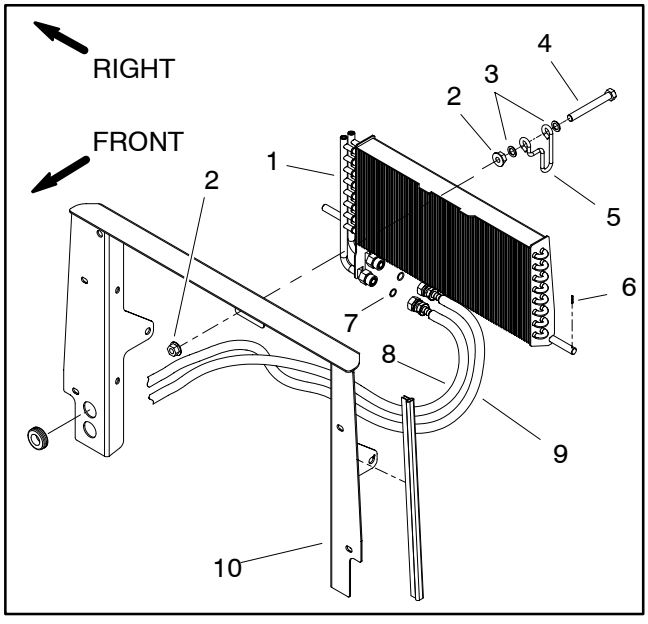

Figure 112

1. **Oil cooler**
2. **Flange nut**
3. **Washer**
4. **Cap screw**
5. **Clamp**
6. **Roll pin**
7. **O–ring (2 used)**
8. **Hydraulic hose**
9. **Hydraulic hose**
10. **Radiator frame**

Chapter 5

Electrical System

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Electrical Schematics and Diagrams

The electrical schematics and other electrical drawings for the Groundsmaster 7200 and 7210 are located in Chapter 8 – Foldout Diagrams.

Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local tool supplier.

Multimeter

The multimeter can test electrical components and circuits for current, resistance or voltage.

NOTE: Toro recommends the use of a DIGITAL Volt–Ohm–Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

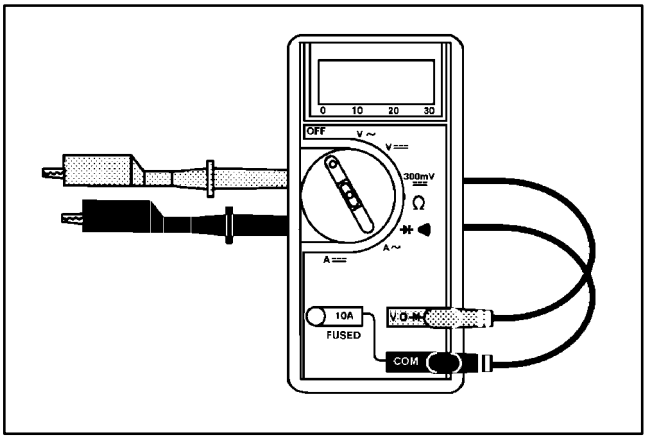

Figure 1

Skin–Over Grease

Special non–conductive grease which forms a light protective skin to help waterproof electrical switches and contacts.

Toro Part Number: **505–165**

Figure 2

Battery Terminal Protector

Battery Terminal Protector is an aerosol spray that should be used on battery terminals to reduce corrosion problems. Apply terminal protector after battery cable has been secured to battery terminal.

Toro Part Number: **107–0392**

Figure 3

Dielectric Gel

Dielectric gel should be used to prevent corrosion of connection terminals. To ensure complete coating of terminals, liberally apply gel to both component and wire harness connector, plug connector to component, unplug connector, reapply gel to both surfaces and reconnect harness connector to component. Connectors should be thoroughly packed with gel for effective results.

Toro Part Number: **107–0342**

Figure 4

Battery Hydrometer

Use the Battery Hydrometer when measuring specific gravity of battery electrolyte. Obtain this tool locally.

Figure 5

Troubleshooting

CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Chapter 8 – Foldout Diagrams).

Make sure that all machine interlock switches are functioning correctly for proper troubleshooting and safety.

NOTE: Use the Standard Control Module input and output LED's when troubleshooting a Groundsmaster 7200 or 7210 electrical problem.

Starting Problems

Problem	Possible Causes
Starter solenoid clicks, but starter will not crank. **NOTE:** If the starter solenoid clicks, the problem is not in the interlock circuit.	Low battery charge. Loose or corroded battery cables. Loose or corroded ground connection. Faulty wiring at the starter. Faulty starter solenoid.
Nothing happens when start attempt is made.	The traction levers are not in neutral locked position. The traction neutral switch(es) is(are) faulty or out of adjustment. Parking brake is disengaged with seat unoccupied. PTO switch is in the ON (up) position or is faulty. The engine coolant temperature is excessive or the engine high temperature shutdown switch is faulty. The battery is discharged. Loose or corroded battery cables. Loose or corroded ground connection. Fuse F1, F2, F3 and/or F4 are/is faulty. Fusible link harness at the engine starter motor is faulty. Wiring in the crank circuit is loose, corroded or damaged (see Chapter 8 – Foldout Diagrams). The ignition switch is faulty. Starter solenoid wiring is loose, corroded or damaged. Starter solenoid is faulty. The Standard Control Module is faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	The fuel tank is empty. Wiring in the engine crank circuit is loose, corroded or damaged (see Chapter 8 – Foldout Diagrams). Fuel filter is plugged. Engine and/or fuel may be too cold. Engine run solenoid or circuit wiring is faulty. Engine fuel pump or circuit wiring is faulty. The engine glow circuit does not operate properly. Engine or fuel system is malfunctioning (see Chapter 3 – Kubota Diesel Engine).
The glow plug circuit does not operate properly.	Wiring in the engine glow circuit (see Chapter 8 – Foldout Diagrams) is loose, corroded or damaged. Engine glow plug(s) is (are) faulty. The glow relay or glow plug controller is faulty. Fusible link harness at the engine starter motor is faulty. Fuse F1, F2 and/or F3 are/is faulty.
Engine cranks (but should not) with the PTO switch in the ON (up) position.	The PTO switch or circuit wiring is faulty. The Standard Control Module is faulty.
Engine starts, but stops when the ignition switch is released from the START position.	Engine fuel stop solenoid or circuit wiring is faulty (pull coil operates but hold coil or circuit wiring is faulty). The ignition switch is faulty.

General Run and Transport Problems

Problem	Possible Causes
Engine stops during operation (operator sitting on seat).	Operator not in center of seat (seat switch is not depressed). The engine temperature is excessive (above 240°F / 115°C). The engine high temperature shutdown switch is faulty. Machine is being operated on a slope with a low fuel level. The parking brake was engaged or the parking brake switch is faulty. The seat switch is faulty. Fuse F1, F3 and/or F4 are/is faulty. The engine run solenoid or fuel pump failed. Wiring in the run circuit is faulty or disconnected (see Chapter 8 – Foldout Diagrams).
Battery does not charge.	Loose or broken wire(s) (see Chapter 8 – Foldout Diagrams). Engine alternator belt is loose or damaged. The alternator is faulty. The battery is faulty. The alternator warning lamp is faulty. The alternator warning lamp wiring is loose, corroded or damaged. The fusible link harness at the engine starter motor is faulty.

Cutting Deck Operating Problems

Problem	Possible Causes
The cutting deck will not run with the PTO switch in the ON (up) position.	The operator seat is unoccupied. Oil level in hydraulic tank is low. The seat switch or circuit wiring is faulty. Wiring to the transmission PTO solenoid valve coil is loose, corroded or damaged (see Chapter 8 – Foldout Diagrams). The transmission PTO solenoid valve coil is faulty. The PTO switch is faulty. Engine temperature is excessive (above 220ºF / 105ºC). High temperature warning switch or circuit wiring is faulty. The Standard Control Module is faulty. Transmission hydraulic solenoid valve is faulty (see Chapter 4 – Hydraulic System). PTO clutch in transmission is worn or damaged (see Chapter 4 – Hydraulic System). Transmission pressure valve or charge pump is faulty (see Chapter 4 – Hydraulic System).

Electrical System Quick Checks

Battery Test (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals.

Set multimeter to the DC volts setting. The battery should be at a temperature of 60º to 100ºF (16º to 38ºC). The ignition key should be off and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post. Measure and record the battery voltage. Use the chart at right to determine charge level of battery.

NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information.

Voltage Measured	Battery Charge Level
12.68 V (or higher)	Fully charged (100%)
12.45 V	75% charged
12.24 V	50% charged
12.06 V	25% charged
11.89 V	0% charged

Charging System Test

This is a simple test used to determine if a charging system is functioning. It will tell you if the charging system has an output, but not its capacity.

Tool required: Digital multimeter set to DC volts.

Test instructions: Connect the positive (+) multimeter lead to the positive battery post and the negative (–) multimeter lead to the negative battery post. Keep the test leads connected to the battery posts and record the battery voltage.

NOTE: Upon starting the engine, the battery voltage will drop and then should increase once the engine is running.

NOTE: Depending upon the condition of the battery charge and battery temperature, the charging system voltage will increase at different rates as the battery charges.

Start the engine and run at high idle **(3200 to 3250 RPM)**. Allow the battery to charge for at least 3 minutes. Record the battery voltage.

After running the engine for at least 3 minutes, battery voltage should be at least 0.50 volt higher than initial battery voltage.

Example of a charging system that is functioning:

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.85 v
Difference	= +0.55 v

Glow Plug System Test

This is a fast, simple test that can help to determine the integrity and operation of the Groundsmaster glow plug system. The test should be run anytime hard starting (cold engine) is encountered on a diesel engine equipped with a glow plug system.

Tool(s) required: Digital multimeter and/or inductive Ammeter (AC/DC Current Transducer).

Test instructions: Properly connect the ammeter to the digital multimeter (refer to manufacturers' instructions). Set the multimeter to the correct scale. With the ignition switch in the OFF position, place the ammeter pickup around the main glow plug power supply wire and read the meter prior to activating the glow plug system. Adjust the meter to read zero (if applicable). Activate the glow plug system and record the multimeter results.

The glow plug system on Groundsmaster 7200 and 7210 machines should have a reading of approximately 27 Amps.

Check Operation of Interlock Switches

CAUTION

Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine.

Groundsmaster 7200 and 7210 machines are equipped with a Standard Control Module (SCM) which monitors interlock switch operation. Information on the SCM is described in the Component Testing section of this Chapter. Testing of individual interlock switches is included in the Component Testing section of this Chapter.

NOTE: The machine is equipped with an interlock switch on the parking brake. The engine will stop if the traction control levers are moved from the neutral locked position with the parking brake engaged.

1. Make sure all bystanders are away from the area of operation. Keep hands and feet away from cutting deck (or implement).

2. With operator in the seat, the engine must not start with either the PTO switch in the ON position or the traction control levers moved from the neutral locked position. Correct problem if machine is not operating properly.

3. With operator in the seat, the traction control levers in the neutral locked position, the parking brake off and the PTO switch in the OFF position, the engine should start. Lift off the seat and slowly move traction control levers from the neutral locked position, the engine should stop in one to three seconds. Correct problem if machine is not operating properly.

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the ignition switch connector before doing a continuity check on the switch).

NOTE: For engine component testing information, see the Kubota Workshop Manual, Diesel Engine, 05 Series.

CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Ignition Switch

The ignition (key) switch has three positions: OFF, ON/PREHEAT and START (Fig. 6). The switch terminals are identified as shown in Figure 7.

The Standard Control Module (SCM) monitors the operation of the ignition switch. When the ignition switch is in the ON position, the SCM power input LED should be illuminated.

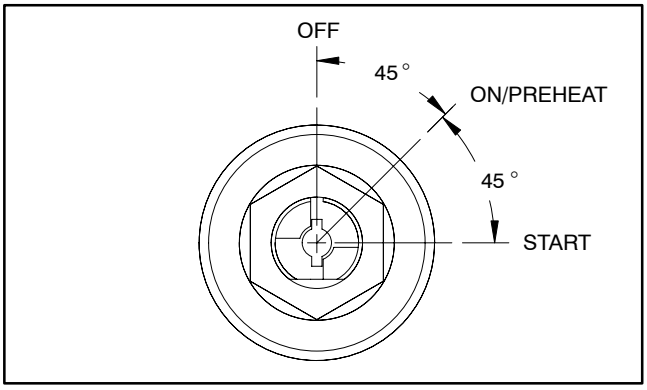

Figure 6

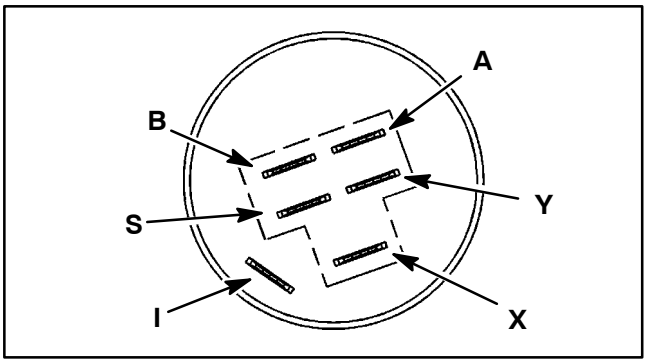

Figure 7

Testing

1. Before disconnecting the ignition switch for testing, the switch and its circuit wiring should be tested as a SCM input (see Standard Control Module in this section).

2. If the SCM verifies that the ignition switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the SCM determines that the ignition switch and circuit wiring **are not** functioning correctly, test ignition switch as follows:

   A. Make sure ignition switch is in the OFF position. Disconnect wire harness connector from ignition switch.

   B. The circuitry of the ignition switch is shown in the chart in the right column. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

   C. Replace ignition switch if necessary.

   D. If the ignition switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematics and Circuit Drawings in Chapter 8 – Foldout Diagrams).

   E. Connect machine wire harness connector to ignition switch.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	NONE	NONE
ON	B + A + I	X + Y
START	B + S + I	NONE

Indicator Lights

Charge Indicator Light

The charge indicator light should come on when the ignition switch is in the ON position with the engine not running. Also, it should illuminate with an improperly operating charging circuit while the engine is running.

Engine Oil Pressure Light

The engine oil pressure light should come on when the ignition switch is in the ON position with the engine not running. Also, it should illuminate with the engine running if the engine oil pressure drops to an unsafe level.

IMPORTANT: If the oil pressure indicator light is illuminated with the engine running, shut off the engine immediately.

To test the oil pressure light and circuit wiring, ground the green wire attached to oil pressure switch located on the engine near the oil filter. Turn ignition switch to the ON position; the engine oil pressure light should come on indicating correct operation of the indicator light and circuit wiring.

High Temperature Warning Light

If the engine coolant temperature reaches 220ºF (105ºC) (approximate), the high temperature warning light will come on.

NOTE: The PTO will disengage if the engine coolant temperature reaches 220ºF (105ºC) (approximate).

To test the high temperature warning light and circuit wiring, turn ignition switch to the ON position and ground the yellow wire attached to high temperature warning switch located on the engine water pump housing (see High Temperature Warning Switch in this Chapter). The high temperature warning light should illuminate.

Glow Plug Indicator Light

The glow plug light should come on when the ignition switch is placed in the ON position prior to placing the ignition switch in START. The light should stay lit for approximately 10 seconds while the ignition switch is left in the ON position.

Testing Indicator Lights

1. Apply 12 VDC to terminals 1A and 2A (Fig. 9).
2. Ground terminals 1B and 2B (Fig. 9).
3. Both indicator lights should illuminate.

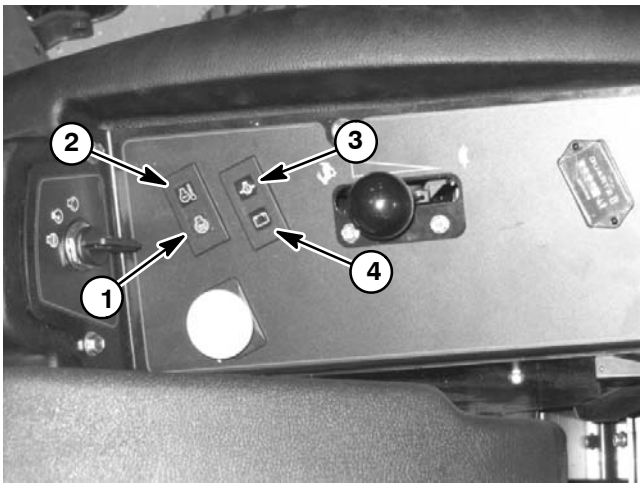

Figure 8

1. Glow plug indicator light
2. High temp warning light
3. Oil pressure light
4. Charge indicator light

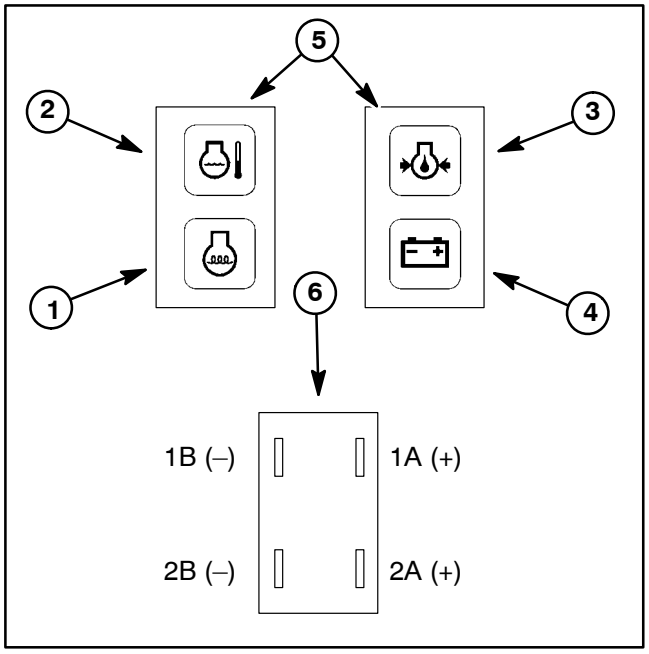

Figure 9

1. Glow plug indicator
2. High temperature
3. Engine oil pressure
4. Charge indicator
5. Indicator light front
6. Indicator light back

Hour Meter

1. Make sure ignition switch is in the OFF position. Locate the hour meter and disconnect the wire harness electrical connector from the meter.

2. Connect the positive (+) terminal of a 12 VDC source to the positive terminal of the hour meter.

3. Connect the negative (–) terminal of the voltage source to the other terminal of the hour meter.

4. The hour meter should move 1/10 of an hour in six minutes.

5. Disconnect the voltage source from the hour meter.

6. Replace the hour meter if necessary.

7. Connect harness electrical connector to the hour meter.

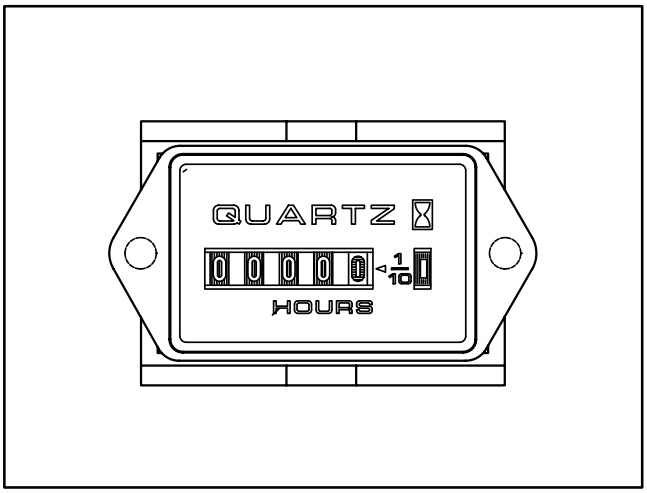

Figure 10

PTO Switch

The PTO switch is located on the control panel (Fig. 11). The PTO switch is pulled up to engage the PTO (cutting deck or implement).

The Standard Control Module (SCM) monitors the position of the PTO switch (up or down). Using inputs from the PTO switch and other switches in the interlock system, the SCM controls the energizing of the transmission solenoid valve and thus, the PTO. If the ignition switch is in the ON position and the PTO switch is engaged, the SCM PTO switch input LED should be illuminated.

IMPORTANT: During machine operation, if the PTO shuts down and the console temperature warning light is illuminated due to excessive engine coolant temperature, avoid shutting off the engine. Under this condition, the operator should push the PTO knob down, slowly drive to a safe flat area, move the throttle lever to the SLOW position, move the traction control levers into the neutral locked position and engage the parking brake. The engine should be allowed to idle for several minutes while it cools to a safe level. Then, the cooling system should be checked before returning the machine to service.

Testing

1. Before disconnecting the PTO switch for testing, the switch and its circuit wiring should be tested as a SCM input (see Standard Control Module in this section).

2. If the SCM verifies that the PTO switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the SCM determines that the PTO switch and circuit wiring **are not** functioning correctly, test PTO switch as follows:

A. Make sure ignition switch is in the OFF position. Locate PTO switch for testing.

B. Disconnect machine wire harness electrical connector from the PTO switch.

C. The PTO switch terminals are identified as shown in Fig. 12. The circuitry of the PTO switch is shown in ithe chart in the right column. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

D. Replace PTO switch if necessary.

E. If the PTO switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematics and Circuit Drawings in Chapter 8 – Foldout Diagrams).

F. Connect machine wire harness connector to PTO switch. Check PTO switch operation.

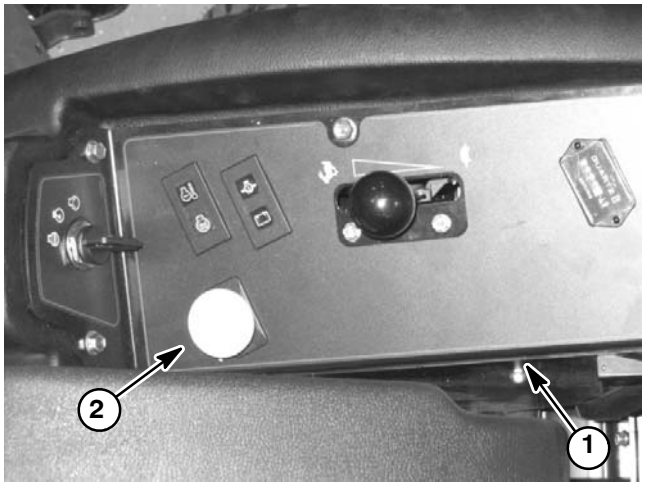

Figure 11

1. **Control panel**
2. **PTO switch**

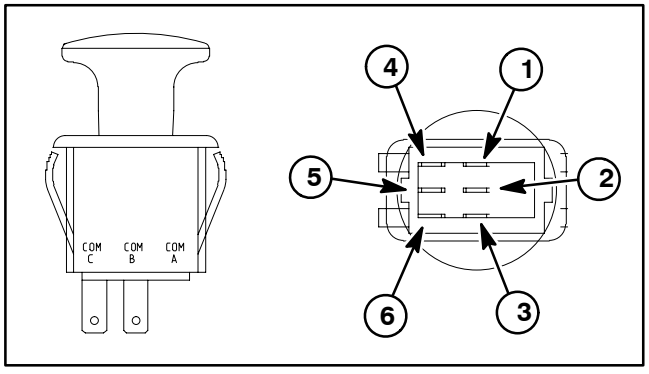

Figure 12

1. **COM B terminal**
2. **NO B terminal**
3. **NC B terminal**
4. **COM C terminal**
5. **NO C terminal**
6. **NC C terminal**

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
OFF (DOWN)	COM B + NC B COM C + NC C	COM B + NO B COM C + NO C
ON (UP)	COM B + NO B COM C + NO C	COM B + NC B COM C + NC C

Neutral Switches

The Groundsmaster 7200 and 7210 use two (2), identical neutral switches. These neutral switches are normally open and close when the traction levers are in the neutral locked position. The neutral switches are located under the front panel beneath the operator seat (Figs. 13 and 14).

The Standard Control Module (SCM) monitors the status of the neutral switches. If the ignition switch is in the ON position and the traction levers are **both** in the neutral locked position, the SCM Neutral input LED should be illuminated. The switches are connected in series so both of the switches must be closed for the neutral input to be completed for the SCM.

Testing

1. Before disconnecting a neutral switch for testing, the switch and its circuit wiring should be tested as a SCM input (see Standard Control Module in this section).

2. If the SCM verifies that the neutral switches and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the SCM determines that the neutral switch and circuit wiring **are not** functioning correctly, test each neutral switch as follows:

   A. Make sure ignition switch is in the OFF position. Locate neutral switches for testing.

   B. Disconnect machine wire harness electrical connector from the neutral switch.

   C. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

   D. When the switch plunger is extended there should be no continuity (open) between the switch terminals.

   E. When the switch plunger is depressed, there should be continuity (closed) between the switch terminals.

   F. Replace switch if necessary.

   G. If the neutral switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematics and Circuit Drawings in Chapter 8 – Foldout Diagrams).

   H. Connect machine wire harness connector to neutral switch. Check neutral switch operation.

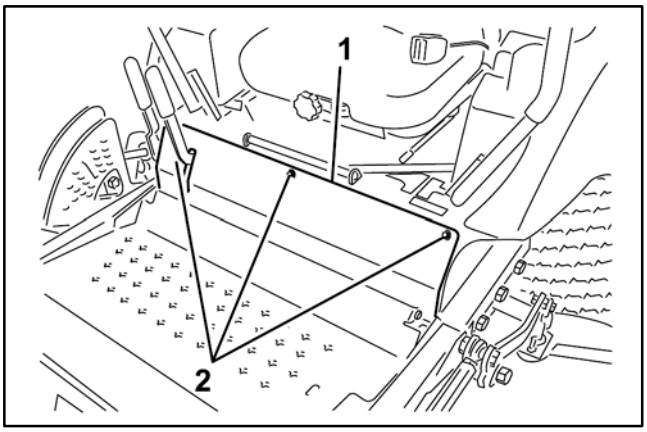

Figure 13

1. **Front panel**
2. **Washer head screw**

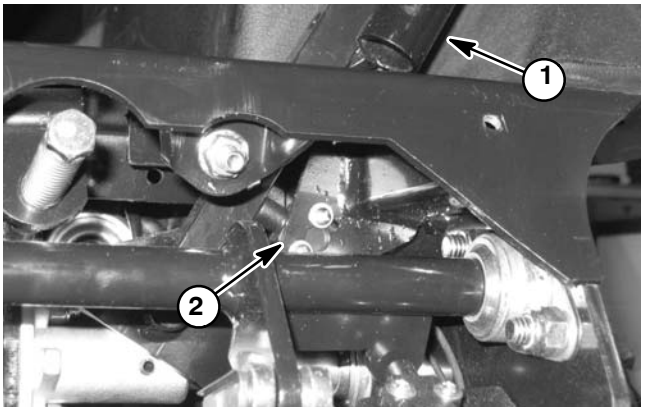

Figure 14

1. **Traction lever (LH)**
2. **Neutral switch**

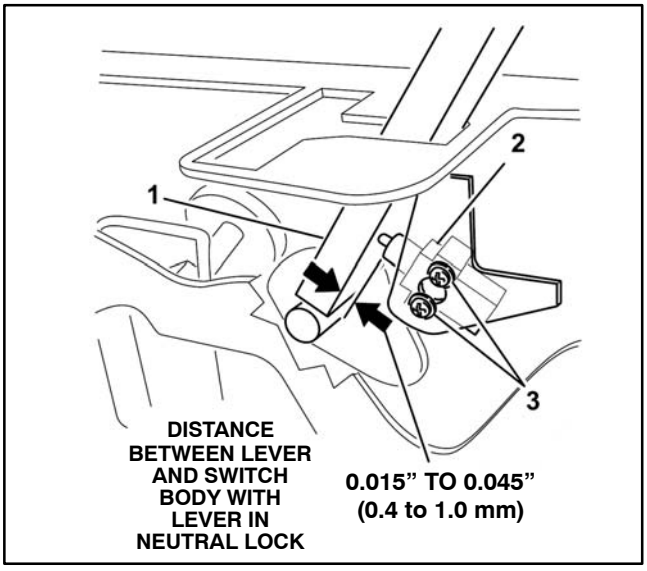

Figure 15

1. **Traction lever**
2. **Neutral switch**
3. **Screw**

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. If the traction system or PTO switch is engaged when the operator raises out of the seat, the engine will stop. The seat switch and its electrical connector (Fig. 16) are located directly under the seat.

The Standard Control Module (SCM) monitors the status of the seat switch. If the ignition switch is in the ON position and the seat is occupied, the SCM in seat input LED should be illuminated.

Testing

1. Before disconnecting the seat switch for testing, the switch and its circuit wiring should be tested as a SCM input (see Standard Control Module in this section).

2. If the SCM verifies that the seat switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the SCM determines that the seat switch and circuit wiring **are not** functioning correctly, test seat switch as follows:

A. Make sure ignition switch is in the OFF position. Tilt seat assembly up to gain access to seat switch electrical connections.

NOTE: There is a short wire harness that is used to connect the sen at switch to the main wire harness of the machine. This seat switch harness is between the seat and the seat plate.

B. Disconnect machine wire harness electrical connector from the seat switch harness electrical lead under the operator seat (Fig. 16).

C. Check the continuity of the seat switch by connecting a multimeter (ohms setting) across the seat switch harness connector terminals.

D. With no pressure on the seat, there should be no continuity between the seat switch harness terminals.

E. Press directly onto the seat switch through the seat cushion. There should be continuity between the seat switch harness terminals as the seat cushion approaches the bottom of its travel indicating that the seat switch is functioning.

WARNING

If seat switch service is necessary, remove seat from seat plate to access switch. To prevent injury, DO NOT attempt to reach switch through openings in seat plate.

F. If the continuity test is incorrect, remove seat (see Operator Seat in Chapter 6 – Chassis). Check seat switch and/or seat switch harness for continuity. Repair or replace components as needed.

G. If the seat switch tests correctly and a circuit problem still exists, check machine wire harness (see Electrical Schematics and Circuit Drawings in Chapter 8 – Foldout Diagrams).

H. After seat switch testing is complete, connect machine wire harness connector to seat switch electrical lead. Lower seat assembly. Check seat switch operation.

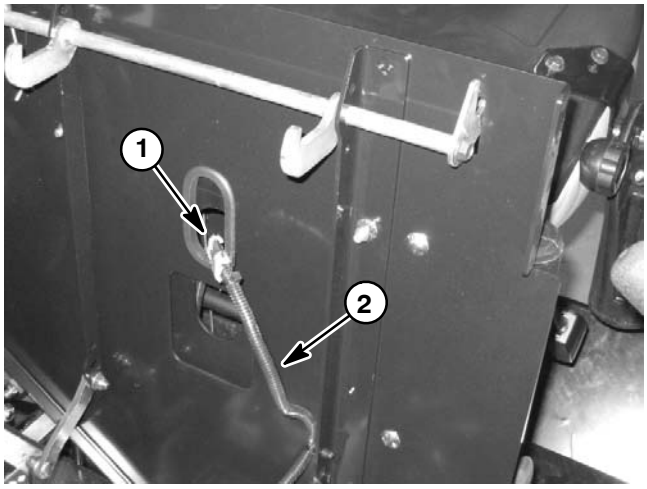

Figure 16

1. Seat harness connector 2. Machine wire harness

Parking Brake Switch

The parking brake switch is a normally closed switch that opens when the parking brake is applied. The switch is located under the front panel (Fig. 17 and 18).

The Standard Control Module (SCM) monitors the status of the parking brake switch. If the ignition switch is in the ON position and the parking brake is disengaged, the SCM Parking Brake Off input LED should be illuminated. The parking brake switch and circuit wiring **should** be tested as a SCM input before performing the following testing procedure.

Testing

1. Before disconnecting the parking brake switch for testing, the switch and its circuit wiring should be tested as a SCM input (see Standard Control Module in this section).

2. If the SCM verifies that the brake switch and circuit wiring **are** functioning correctly, no further brake switch testing is necessary.

3. If the SCM determines that the brake switch and circuit wiring **are not** functioning correctly, test switch as follows:

A. Make sure ignition switch is in the OFF position. Locate parking brake switch for testing.

B. Disconnect machine wire harness electrical connector from the parking brake switch.

C. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

D. When the switch plunger is extended there should be continuity (closed) between the switch terminals.

E. When the switch plunger is depressed, there should be no continuity (open) between the switch terminals.

F. Replace brake switch if necessary.

G. If the brake switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematics and Circuit Drawings in Chapter 8 – Foldout Diagrams).

H. Connect switch connector to machine wire harness. Check brake switch operation.

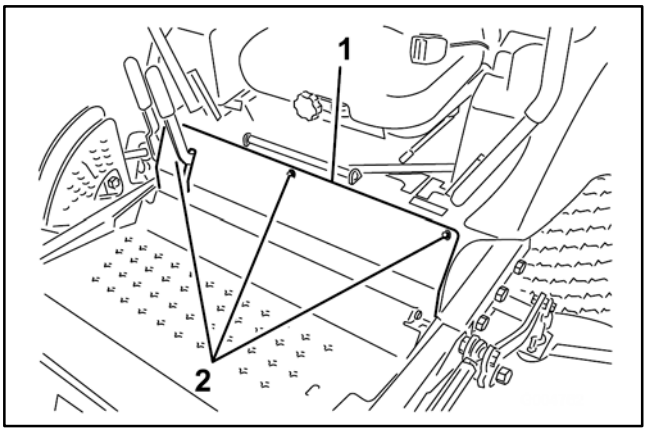

Figure 17

1. **Front panel**
2. **Washer head screw**

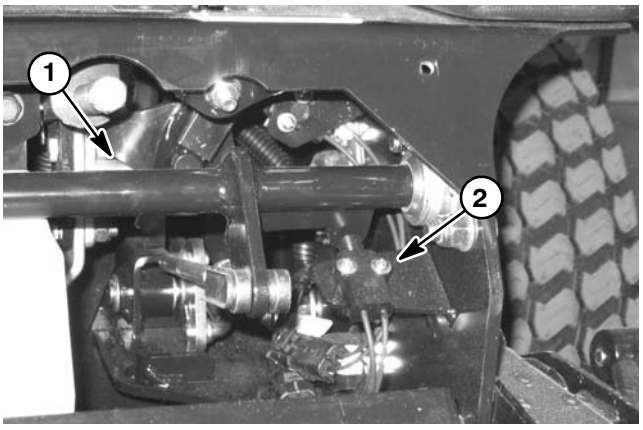

Figure 18

1. **Brake lever assembly**
2. **Brake switch**

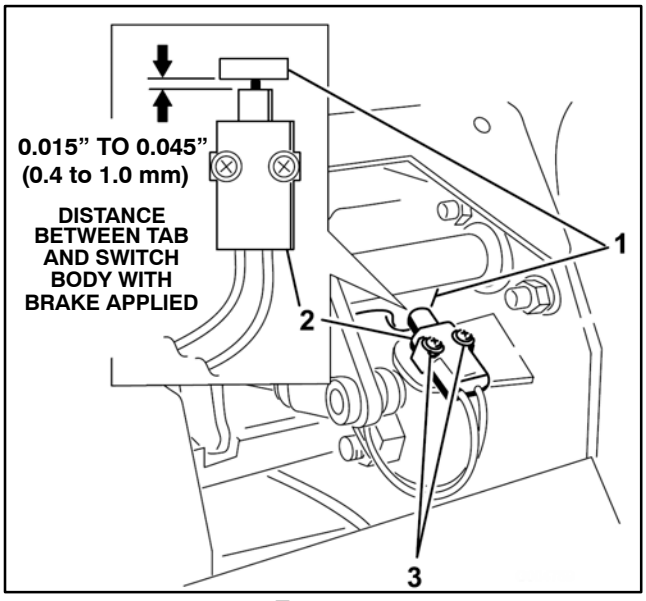

Figure 19

1. **Brake shaft tab**
2. **Parking brake switch**
3. **Screw**

Standard Control Module

Groundsmaster 7200/7210 machines are equipped with a Standard Control Module (SCM) to monitor and control electrical components required for safe operation. The SCM is attached to the control panel cover (Fig. 20).

Inputs from the ignition, neutral, parking brake, PTO, seat, high temperature warning switch and high temperature shutdown switch are monitored by the SCM. Current output to the PTO, engine starter motor and engine run components (fuel pump and engine run solenoid) are controlled based on the inputs monitored by the SCM.

The SCM can be used to check operation of machine switches by monitoring the SCM LEDs. If a SCM LED does not illuminate (e.g. the In Seat input LED does not illuminate when the seat is occupied and the ignition switch is in the ON position), testing of the switch, fuses and circuit wiring would be required.

The SCM does not connect to an external computer or hand held device, can not be re–programmed and does not record intermittent fault data.

SCM Inputs (Fig. 21)

The Power input LED should be illuminated when the ignition key switch is in the ON position. The Power input LED should also be illuminated when the ignition key switch is in the START position.

The Start input LED should be illuminated when the ignition key switch is in the START position.

The Neutral input LED should be illuminated when both traction control levers are in the neutral locked position.

The Parking Brake Off input LED should be illuminated when the parking brake is **not** applied.

The PTO Switch input LED should be illuminated when the PTO switch is on (pulled out).

The In Seat input LED should be illuminated when the operator is sitting in the seat.

The High Temperature Shutdown input LED should be illuminated when the engine high temperature shutdown switch closes due to engine coolant temperature of 240ºF (115ºC) (approximate).

The High Temperature Warning input LED should be illuminated when the engine high temperature warning switch closes due to engine coolant temperature of 220ºF (105ºC) (approximate).

The Backlap input LED is not used on the Groundsmaster 7200/7210.

SCM Outputs (Fig. 21)

The Start output LED should be illuminated when the ignition key switch is in the START position with the traction control levers **both** in the neutral locked position, the PTO switch OFF and either the seat occupied or parking brake engaged.

The Run output LED should be illuminated when the ignition key switch is in the ON position and inputs from the neutral, parking brake, PTO, seat and engine coolant temperature switches indicate safe engine operation (e.g. seat occupied and parking brake disengaged when traction control levers are moved from the neutral locked position).

The PTO output LED should be illuminated when the ignition key switch is in the ON position and the PTO switch is ON (pulled out). Note: If the SCM High Temperature Warning input LED is illuminated, PTO output LED will not be illuminated and PTO will be disengaged regardless of PTO switch position.

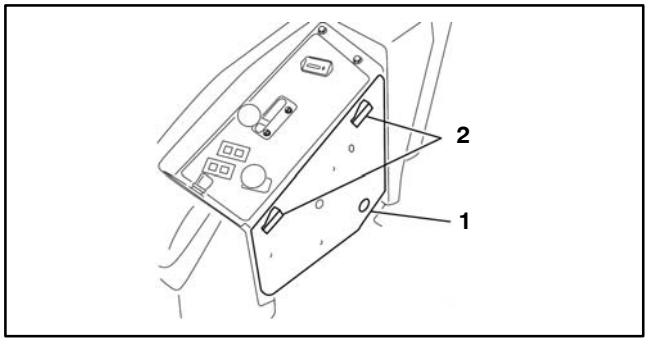

Figure 20

1. **Control panel cover**
2. **Latch**

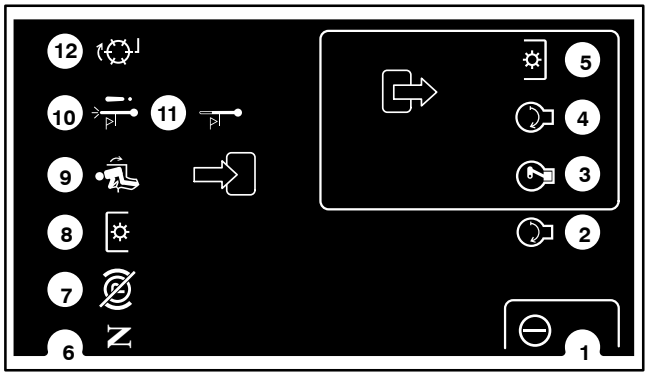

Figure 21

1. **Power input LED**
2. **Start input LED**
3. **Engine run output LED**
4. **Start output LED**
5. **PTO output LED**
6. **Neutral input LED**
7. **Park brake off input LED**
8. **PTO switch input LED**
9. **In seat input LED**
10. **Temp shutdn input LED**
11. **Temp warning input LED**
12. **Backlap input LED**

Standard Control Module Logic Chart

Each line of the following chart identifies the necessary component position (INPUTS) in order for the SCM to energize the appropriate OUTPUTS for machine operation.

Example: To start the engine with an operator in the seat, when the ignition key is in start, the traction control levers both in neutral locked position and the parking brake is not applied, engine components and the engine starter will be energized.

MACHINE FUNCTION	INPUTS: Power	Start	Neutral	Parking Brake Off	PTO Switch	In Seat	High Temperature Warning	High Temperature Shutdown	Backlap	OUTPUTS: Engine Run	Engine Start	PTO
Engine Start (Operator in Seat)	⊖	⊕	⊖	⊖	○	⊖	○	○	NA	⊖	⊖	○
Engine Start (No Operator in Seat)	⊖	⊕	⊖	○	○	○	○	○	NA	⊖	⊖	○
Engine Run (Operator in Seat)	⊖	○	○	⊖	○	⊖	○	○	NA	⊖	○	○
Engine Run (No Operator in Seat)	⊖	○	⊖	○	○	○	○	○	NA	⊖	○	○
Mow	⊖	○	○	⊖	⊖	⊖	○	○	NA	⊖	○	⊕
High Temperature Warning	⊖	○					⊕	○	NA	⊖	⊖	○
High Temperature Shutdown	⊖	○						⊕	NA	○	○	○

KEY TO CHART

⊖	LED ON – Circuit closed to ground
⊕	LED ON – Circuit is energized
○	LED OFF – Circuit is open to ground or circuit is de–energized
	Circuit is not involved with this machine function (LED OFF)
NA	Backlap Input is not used on the Groundsmaster 7200/7210

IMPORTANT: During machine operation, if the PTO shuts down and the console temperature warning light is illuminated, avoid shutting off the engine. Under this condition, the operator should push the PTO knob down, slowly drive to a safe flat area, move the throttle lever to the SLOW position, move the traction control levers into the neutral locked position and engage the parking brake. The engine should be allowed to idle for several minutes while it cools to a safe level. Then, the cooling system should be checked before returning the machine to service.

PTO Solenoid Valve Coil

The hydraulic system on the Groundsmaster 7200 and 7210 uses a solenoid valve coil on the front of the transmission (Fig. 22). When the solenoid valve coil is energized, hydraulic flow is directed to operate the PTO system.

The Standard Control Module (SCM) provides current to the solenoid valve coil based on the position of several inputs. The PTO LED on the SCM will be illuminated when the solenoid valve coil is energized.

Testing

NOTE: The solenoid does not have to be removed from the cartridge valve for testing.

1. Make sure ignition switch is in the OFF position. Unplug wire harness electrical connector from solenoid valve coil.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from from the measured value of the component you are testing.

2. Measure resistance between the two solenoid coil connector terminals. Resistance of the solenoid coil should be approximately **7.5 ohms**.

3. Connect wire harness connector to the solenoid coil.

4. If solenoid coil needs replacement, see PTO Solenoid Valve Coil in the Service and Repairs section of this chapter.

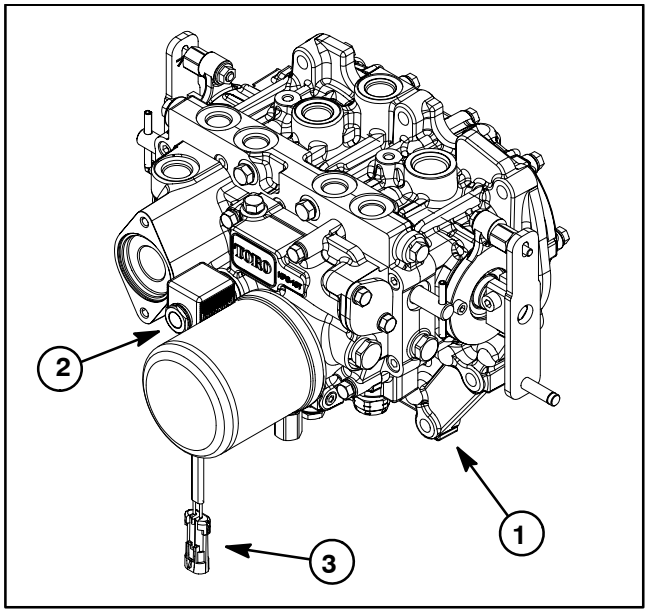

Figure 22

1. **Transmission**
2. **Solenoid valve and coil**
3. **Coil connector**

Fusible Link Harness

The Groundsmaster 7200 and 7210 uses three (3) fusible links for circuit protection. These fusible links are located in a harness that connects the starter B+ terminal to the main wire harness. If any of these links should fail, current to the protected circuit will cease. Refer to Electrical Schematics in Chapter 8 – Foldout Diagrams for additional circuit information.

Make sure that ignition switch is OFF and disconnect negative battery cable from battery terminal. Then disconnect positive cable from battery (see Battery Service in the Service and Repairs section of this chapter). Locate and unplug fusible link connector P1 from machine wire harness. Use a multimeter to make sure that continuity exists between each terminal pin in connector P1 and connector J1 at the starter (Fig. 23). If any of the fusible links are open, replace the fusible link harness.

After testing is complete, make sure that fusible link harness connectors are securely attached to starter and machine wire harness. Connect positive battery cable to battery terminal first and then connect negative cable to battery.

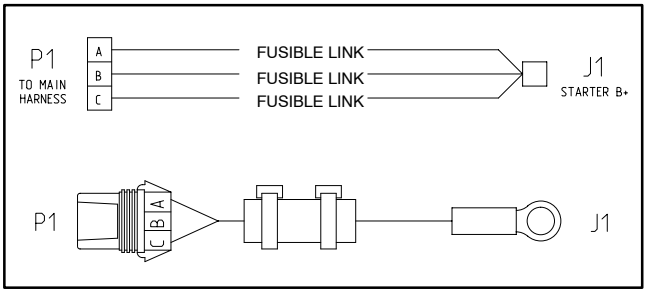

Figure 23

Diode Assembly

The diode assembly is used for circuit protection from inductive voltage spikes when the PTO clutch is de–energized. The diode plugs into the wiring harness under the operator seat.

Testing

The diode (Fig. 24) can be tested using a digital multimeter (diode test or ohms setting) and the table **below**.

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (–) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

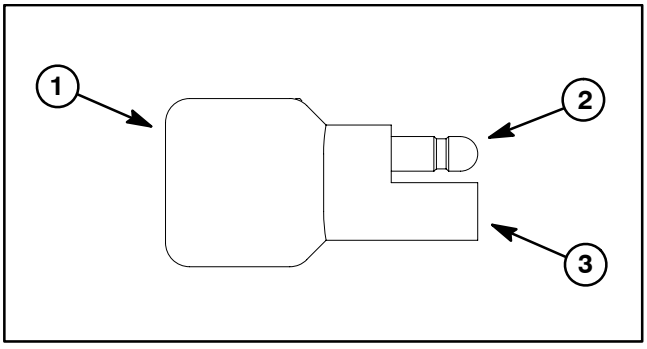

Figure 24

1. **Diode**
2. **Male terminal**
3. **Female terminal**

Glow Relay

The glow relay used on the Groundsmaster 7200 and 7210 allows electrical current to the engine glow plugs when energized. The glow relay is attached to the frame in the engine compartment.

The glow relay is energized by the glow controller when the ignition switch is initially turned to ON/PREHEAT and also when the ignition switch is turned to START.

Testing

1. Raise and support hood.

2. Make sure ignition switch is in the OFF position. Disconnect wire harness electrical connector from glow relay.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from from the measured value of the component you are testing.

3. Verify coil resistance between terminals 85 and 86 with a multimeter (ohms setting). Resistance should be approximately **72 ohms**.

4. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

5. Disconnect voltage and leads from the relay terminals.

6. Connect wire harness electrical connector to glow relay after testing is completed.

7. Close and secure hood.

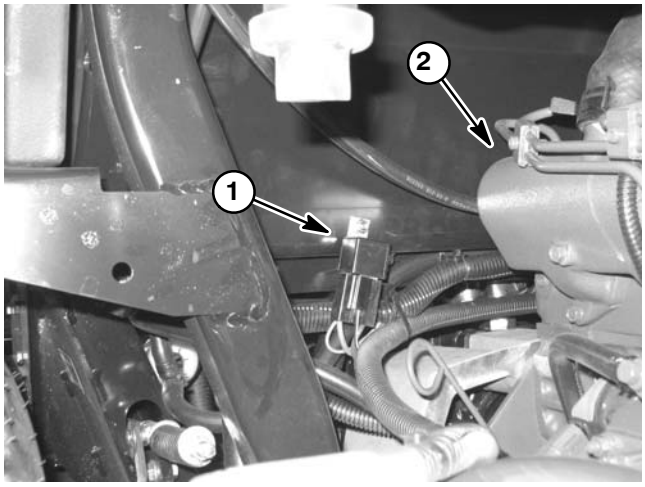

Figure 25

1. Glow relay **2. Engine**

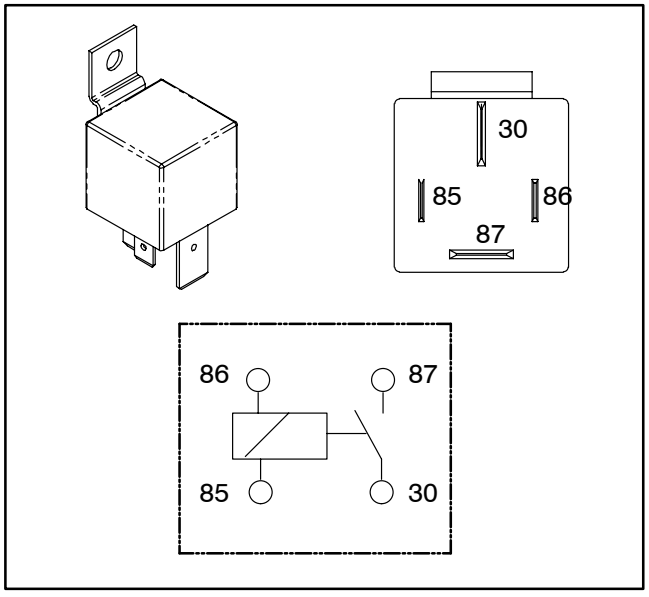

Figure 26

High Temperature Warning Switch

The high temperature warning switch is attached to the water pump housing on the engine and has a yellow wire attached to it (Fig. 27). This switch is normally open and closes when engine coolant temperature reaches approximately 220ºF (105ºC).

When engine coolant temperature rises to approximately 220ºF (105ºC), the high temperature warning switch closes. The closed switch causes the High Temperature Warning Light on the console to illuminate and also provides an input to the Standard Control Module (SCM). This input causes the SCM high temperature warning LED to illuminate and the cutting deck (or implement) to shut down. The temperature warning switch and circuit wiring **should** be tested as a SCM input before performing the following testing procedure.

Testing

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, apply parking brake and remove key from ignition switch. Open hood to gain access to engine.

CAUTION

Make sure engine is cool before removing the temperature warning switch from engine. Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

2. Lower the coolant level in the engine, remove wire harness connector from high temperature warning switch and remove the switch from the engine.

3. Put the end of the switch in a container of oil with a thermometer and slowly heat the oil (Fig. 28).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

NOTE: Prior to taking resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from from the measured value of the component you are testing.

4. Check resistance of the warning switch with a multimeter (ohms setting) as the temperature increases. The high temperature warning switch is normally open and should close from 216º to 226ºF (102º to 108ºC).

5. After testing, install warning switch to the engine housing.

   A. Clean threads of housing and switch thoroughly. Apply thread sealant to the threads of the switch.

   B. Thread warning switch into the housing. Torque switch from **16 to 20 ft–lb (21.7 to 27.1 N–m)**.

   C. Reconnect harness wire connector to warning switch.

6. Fill engine cooling system.

7. Lower and secure hood.

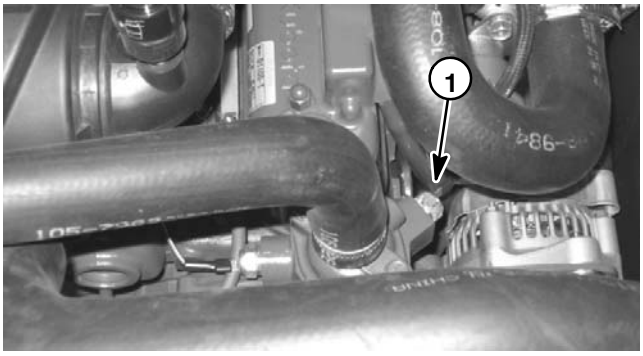

Figure 27

1. **High temperature warning switch**

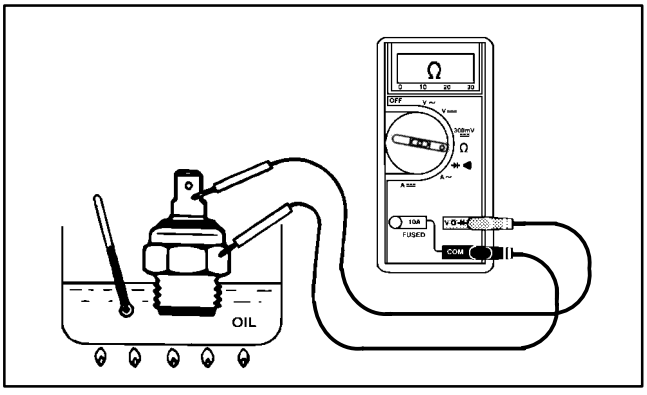

Figure 28

High Temperature Shutdown Switch

The high temperature shutdown switch is located on the water pump housing (Fig. 29). The high temperature shutdown switch is normally open and closes when engine coolant temperature reaches approximately 240ºF (115ºC). When excessive engine coolant temperature causes the shutdown switch to close, the engine shuts down. There is a blue/white wire attached to the shutdown switch.

The Standard Control Module (SCM) monitors the operation of the high temperature shutdown switch. If excessive engine coolant temperature causes the high temperature shutdown switch to close, the High Temperature Shutdown LED on the SCM will be illuminated. The switch and its circuit wiring **should** be tested using the SCM before performing the following testing procedure.

Testing

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, apply parking brake and remove key from ignition switch. Open hood to gain access to engine.

CAUTION

Make sure engine is cool before removing the high temperature shutdown switch from engine. Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

2. Lower the coolant level in the engine and remove the high temperature shutdown switch from the engine.

3. Put the end of the switch in a container of oil with a thermometer and slowly heat the oil (Fig. 30).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

4. Check resistance of the switch with a multimeter (ohms setting) as the oil temperature increases. The high temperature shutdown switch is normally open and should close from 234º to 244ºF (112º to 118ºC).

5. Replace shutdown switch if specifications are not met.

6. After testing is complete, install shutdown switch to the engine housing.

   A. Clean threads of housing and switch thoroughly. Apply thread sealant to the threads of the switch.

   B. Thread switch into the housing. Torque switch from **22 to 28 ft–lb (29.4 to 39.2 N–m)**.

   C. Reconnect harness wire to shutdown switch.

7. Fill engine cooling system.

8. Lower and secure hood.

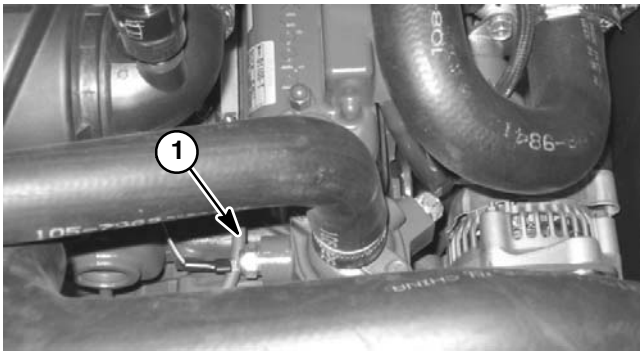

Figure 29

1. **High temperature shutdown switch**

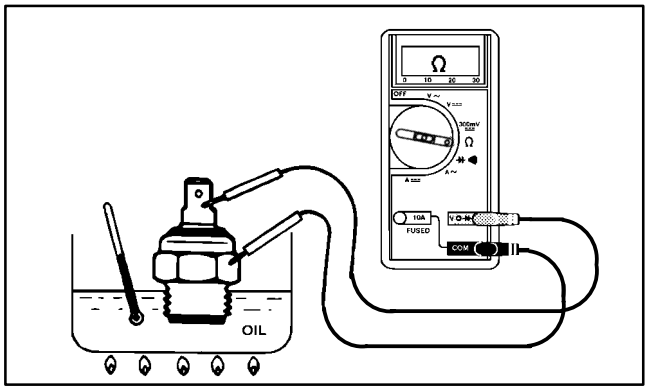

Figure 30

Dual Temperature Switch (Polar Trac™ Machines)

On machines equipped with Polar Trac™, the dual temperature switch includes two normally open circuits used to monitor engine coolant temperature. These switch circuits are the high temperature warning circuit and the high temperature shutdown circuit. The dual temperature switch is attached to the engine water pump housing (Fig. 31).

When engine coolant temperature rises to approximately 220ºF (105ºC), the high temperature warning circuit closes. This closed circuit causes the High Temperature Warning Light on the console to illuminate and also provides an input to the Standard Control Module (SCM). This input causes the SCM high temperature warning LED to illuminate and the PTO implement to shut down.

If engine coolant temperature rises to approximately 240ºF (115ºC), the high temperature shutdown circuit closes and provides an input to the Standard Control Module (SCM). This input causes the SCM high temperature shutdown LED to illuminate and the engine to shut down.

The Standard Control Module (SCM) monitors the operation of the dual temperature switch. If excessive coolant temperature causes either switch circuit to close, the appropriate LED on the SCM will be illuminated. The switch and its circuit wiring **should** be tested using the SCM before performing the following testing procedure.

Testing

1. Park machine on a level surface, lower implement, stop engine, apply parking brake and remove key from ignition switch. Open hood to gain access to engine.

CAUTION

Make sure engine is cool before removing the dual temperature switch from engine. Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

2. Lower the coolant level in the engine and remove the dual temperature switch from the engine.

3. Put the end of the switch in a container of oil with a thermometer and slowly heat the oil (Fig. 32).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

4. Check resistance of the switch with a multimeter (ohms setting) as the oil temperature increases.

   A. The high temperature warning circuit is normally open and should close from 214º to 226ºF (101º to 108ºC).

   B. The high temperature shutdown circuit is normally open and should close from 234º to 246ºF (112º to 119ºC).

5. Replace the switch if either of the specifications are not met.

6. After testing is complete, install temperature switch to the engine housing.

   A. Clean threads of housing and switch thoroughly. Apply thread sealant to the threads of the switch.

   B. Thread switch into the housing. Torque switch from **22 to 28 ft–lb (29.4 to 39.2 N–m)**.

   C. Reconnect harness wires to temperature switch.

7. Fill engine cooling system. Lower and secure hood.

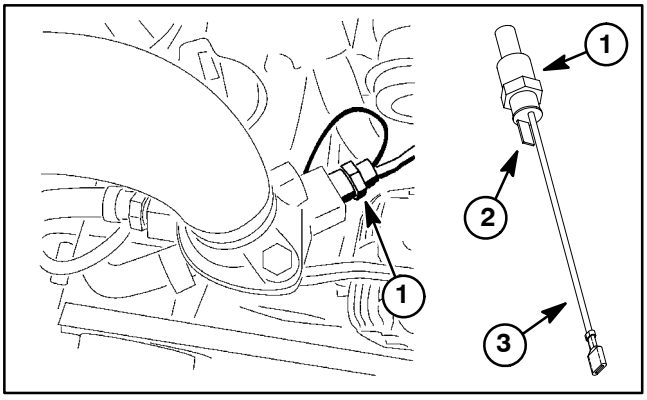

Figure 31

1. **Dual temp switch**
2. **Warning circuit**
3. **Shutdown circuit**

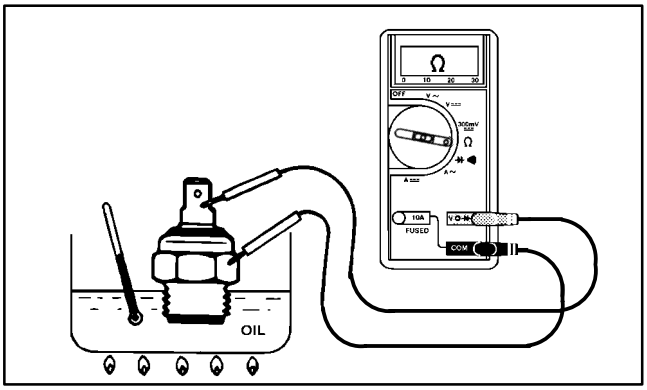

Figure 32

Fuel Pump

The fuel pump is attached to the frame near the fuel filter (Fig. 33).

The Standard Control Module Run output LED will be illuminated when the fuel pump is energized.

Operational Test

1. Park machine on a level surface, lower cutting deck (or implement), stop engine and engage parking brake. Make sure ignition switch is in the OFF position. Unlatch and raise operator seat to gain access to fuel pump.

2. Disconnect electrical connector from the engine fuel stop solenoid to prevent the engine from starting.

3. Disconnect fuel hose (pump discharge) from the inlet fitting on the fuel/water separator (Fig. 34).

4. Make sure fuel hoses attached to the fuel pump are free of obstructions.

5. Place disconnected fuel hose (pump discharge) into a large, graduated cylinder sufficient enough to collect 32 fluid ounces (0.9 liter).

IMPORTANT: When testing the fuel pump, DO NOT turn ignition switch to START.

6. Collect fuel in the graduated cylinder by turning ignition switch to the ON position. Allow pump to run for 30 seconds, then return switch to OFF.

7. Amount of fuel pumped in 30 seconds should be approximately 11.8 fluid ounces (350 ml).

8. Replace fuel pump as necessary. Connect fuel hose to the fuel filter.

9. Connect wire harness electrical connector to the fuel stop solenoid.

10. Bleed fuel system.

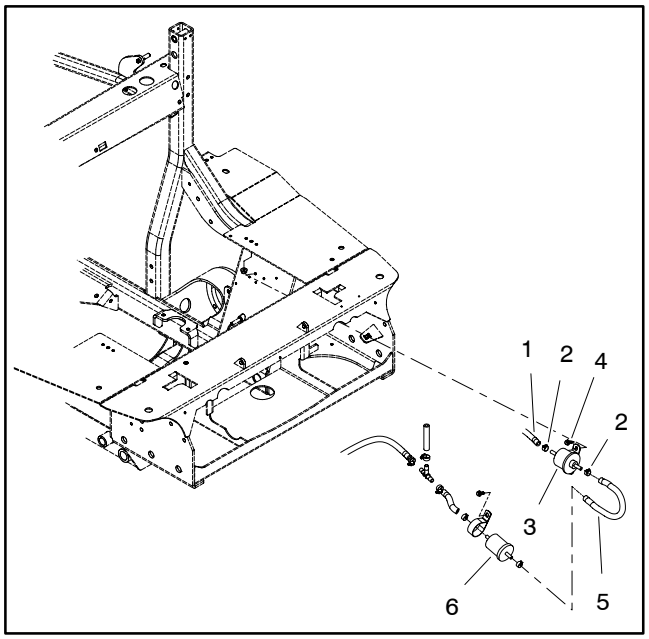

Figure 33

1. **Fuel hose (discharge)**
2. **Hose clamp**
3. **Fuel pump**
4. **Screw (2 used)**
5. **Fuel hose**
6. **Fuel filter**

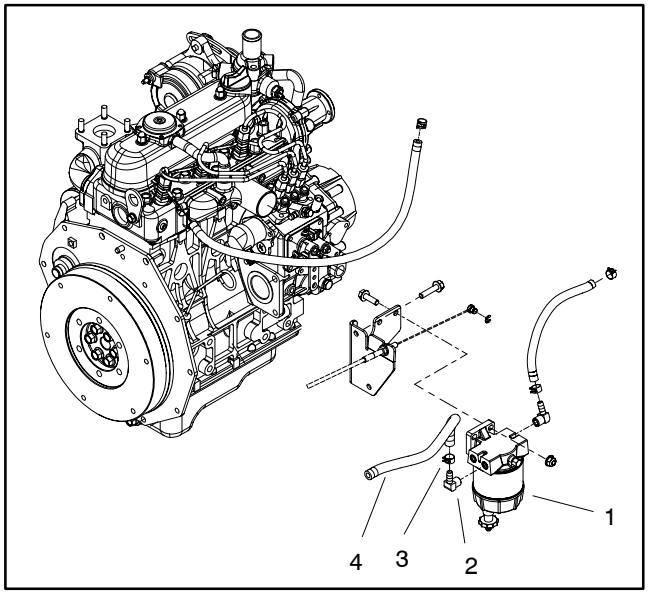

Figure 34

1. **Fuel/water separator**
2. **Inlet fitting**
3. **Hose clamp**
4. **Fuel hose (from pump)**

Fuel Pump Specifications

Pump Capacity	23.5 fl oz/min (695 ml/min)
Pressure	3.3 psi (22.8 kPa)
Max. Current Draw	0.9 amp

Fuel Stop Solenoid

The fuel stop solenoid used on the Groundsmaster 7200/7210 must be energized for the diesel engine to run. The solenoid is mounted to the injection pump on the engine (Fig. 35).

The fuel stop solenoid includes two coils for operation: the pull coil and the hold coil. When the ignition switch is turned to START, the fuel stop solenoid is initially energized and the pull coil retracts the solenoid plunger. Once the plunger is retracted, the hold coil will keep it retracted for continued engine operation. When the solenoid is de–energized, the plunger extends to shut off fuel supply to the engine causing the engine to stop running. The fuel stop solenoid is grounded through the solenoid housing.

The Standard Control Module Run output LED will be illuminated when the fuel stop solenoid hold coil is energized.

NOTE: Refer to Chapter 8 – Foldout Diagrams when troubleshooting the fuel stop solenoid.

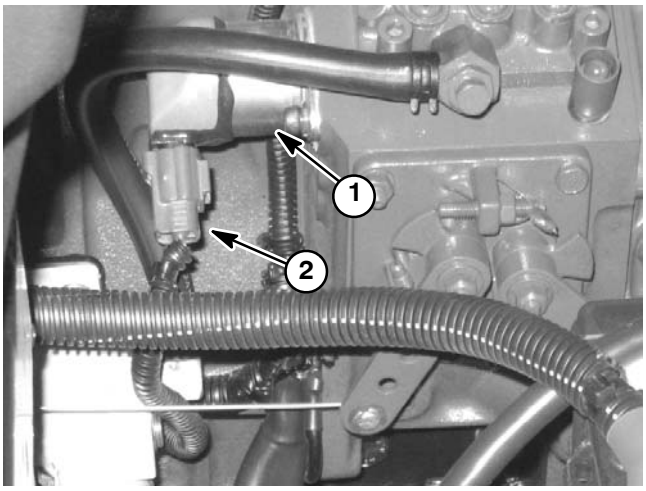

Figure 35

1. **Fuel stop solenoid**
2. **Harness connector**

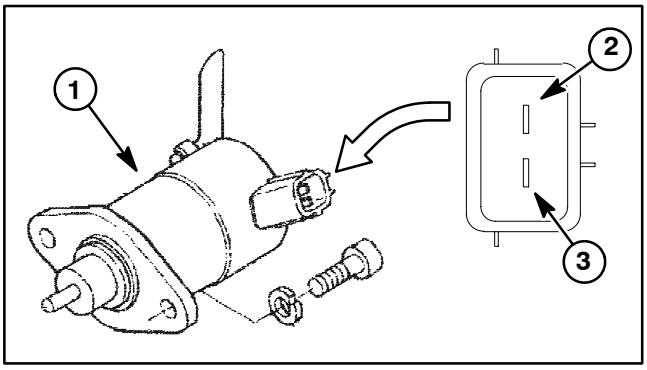

Figure 36

1. **Fuel stop solenoid**
2. **Pull coil terminal**
3. **Hold coil terminal**

In Place Testing

NOTE: Prior to taking small resistance readings with a digital multimeter, short the test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Make sure ignition switch is in the OFF position. Disconnect wire harness connector from fuel stop solenoid.

2. Using a digital multimeter, touch one test lead to the pull coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 36). The resistance of the pull coil should be **less than 1 ohm (but not zero)**.

3. Using a digital multimeter, touch one test lead to the hold coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 36). The resistance of the hold coil should be approximately **15 ohms**.

4. If resistance of either coil is incorrect, replace fuel stop solenoid.

5. Connect wire harness connector to fuel stop solenoid.

Glow Controller

The glow controller is attached to the inside of the control panel cover (Fig. 37).

NOTE: Refer to Chapter 8 – Foldout Diagrams when troubleshooting the glow controller.

Controller Operation

1. When the ignition switch is initially placed in the ON position, the glow controller energizes the glow plugs for 10 seconds. The console glow plug indicator light will also be illuminated for 10 seconds.

2. When the ignition switch is turned to the START position, the glow plugs will energize as long as the switch is held in START. The console glow plug indicator light will **not** light.

3. When the ignition switch is released from the START to the ON position, the glow plugs will de–energize and the console glow plug indicator light will remain off.

Controller Checks

1. Make sure there is power from the battery.

2. Disconnect the wire harness electrical connector from the engine fuel stop solenoid to prevent the engine from starting.

3. Place ignition switch in the ON position. Verify the following while in the ON position:

   A. Glow plug indicator light is on.

   B. Glow relay is energized.

   C. Glow plugs are energized.

   D. Glow plug indicator light goes out and glow plugs de–energize after approximately 10 seconds.

4. Place ignition switch in the START position. Verify the following while in the START position:

   A. Glow plug indicator light is out.

   B. Glow relay is energized.

   C. Glow plugs are energized.

   D. Power exists at terminal 1 of the glow controller.

NOTE: If there is no power to terminal 1 of the glow controller, verify continuity of the circuitry from the ignition switch to the controller and perform Step 4 again (see Chapter 8 – Foldout Diagrams).

5. If any of the conditions in Step 3 are not met or power to terminal 1 exists and any of the other conditions in Step 4 are not met:

   A. Verify continuity of the circuitry from the battery to the glow relay and glow plugs (see Chapter 8 – Foldout Diagrams).

   B. Verify continuity of the circuitry from the battery to ignition switch, glow controller, glow plug indicator light, glow relay and ground (see Chapter 8 – Foldout Diagrams).

   C. Replace parts as necessary.

6. Connect wire harness electrical connector to the fuel stop solenoid.

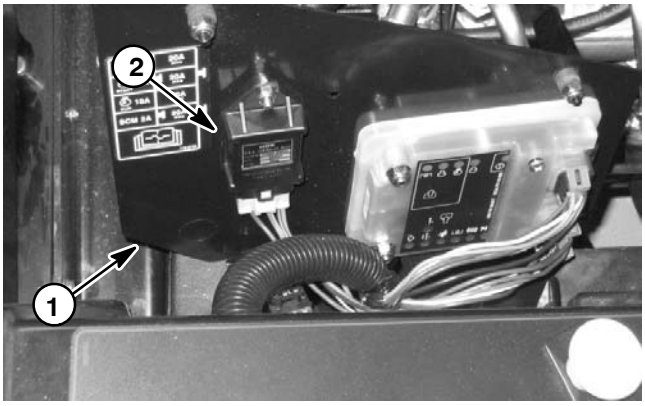

Figure 37

1. Control panel cover **2. Glow plug controller**

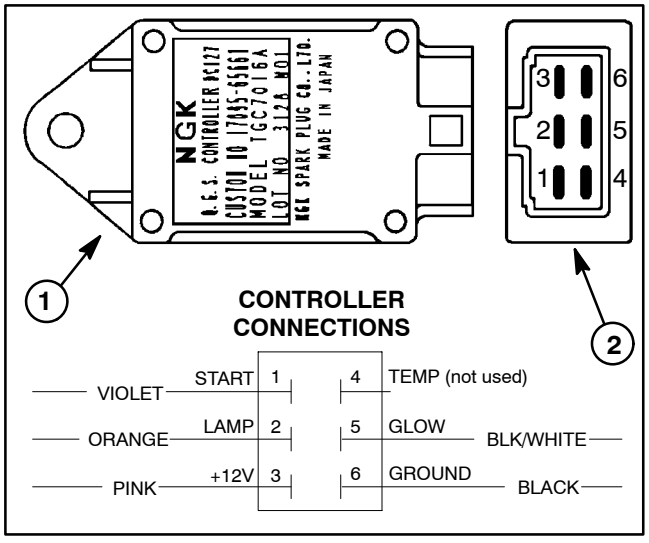

Figure 38

1. Controller top view **2. Controller end view**

Service and Repairs

NOTE: For engine electrical component repair information, see the Kubota Workshop Manual, Diesel Engine, 05 Series.

PTO Solenoid Valve Coil

The PTO solenoid valve coil on the transmission (Fig. 39) can be replaced without opening the hydraulic system.

Removal

1. Park machine on a level surface, lower cutting deck (or implement), engage parking brake, stop engine and remove key from the ignition switch.

2. Disconnect the wire harness electrical connector from the PTO solenoid valve coil connector.

3. Remove the nut from the spool assembly.

4. Slide the coil assembly from the solenoid valve stem (Fig. 40).

5. Clean any corrosion or dirt from the valve stem.

Installation

1. Slide new coil assembly, seals and washers onto the solenoid valve stem. Make sure to properly position seals and washers (Fig. 40).

IMPORTANT: When securing solenoid valve coil to solenoid, do not over–tighten hex nut.

2. Install the hex nut onto the spool assembly and torque nut from **53 to 69 in–lb (5.9 to 7.8 N–m)**.

3. Connect the wire harness electrical connector to the solenoid valve coil connector.

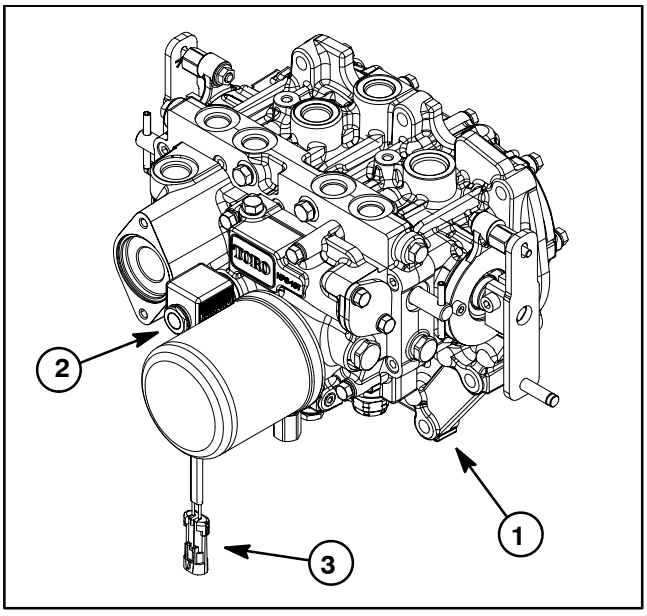

Figure 39

1. **Transmission**
2. **Solenoid valve and coil**
3. **Coil connector**

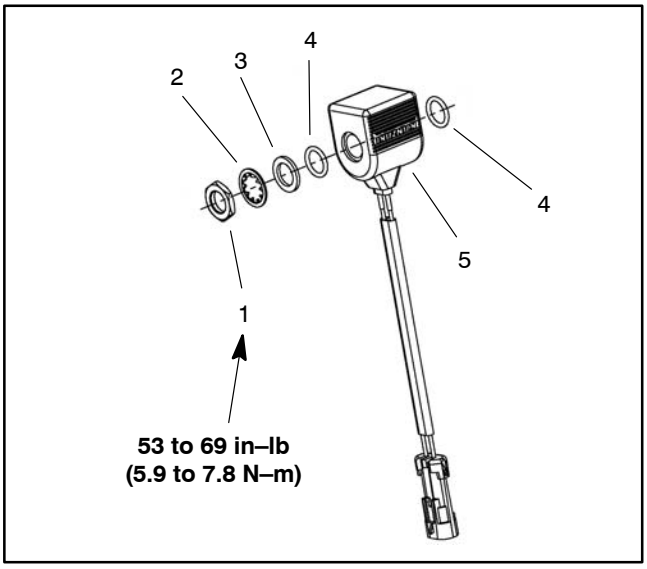

Figure 40

1. **Hex nut**
2. **Lock washer**
3. **Washer**
4. **Seal**
5. **Solenoid valve coil**

Battery Storage

If the machine will be stored for more than 30 days:

1. Make sure ignition switch is in the OFF position. Remove the battery and charge it fully (see Battery Service).

2. Either store battery on a shelf or on the machine.

3. Leave cables disconnected if the battery is stored on the machine.

4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the battery from freezing during storage, make sure it is fully charged (see Battery Service).

Battery Care

1. Battery electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where temperatures are cool.

WARNING

Wear safety goggles and rubber gloves when working with electrolyte. Charge battery in a well ventilated place so gasses produced while charging can dissipate. Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke. Nausea may result if the gases are inhaled. Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

2. Keep top of battery clean by washing periodically with a brush dipped in ammonia or bicarbonate of soda solution. Flush top surface with water after cleaning. Do not remove the fill caps while cleaning.

3. Battery cables must be tight on battery terminals to provide good electrical contact.

WARNING

Connecting cables to the wrong post could result in personal injury and/or damage to the electrical system.

4. If corrosion occurs at battery terminals, disconnect cables. Always disconnect negative (–) cable first. Clean cable clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat terminals with battery terminal protector (Toro Part No. 107–0392) or a light coat of grease to reduce corrosion after connections are made.

5. Check battery electrolyte level every 25 operating hours and every 30 days if machine is in storage.

6. Maintain cell level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

CAUTION

When working with batteries, use extreme caution to avoid splashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Electrolyte Specific Gravity
Fully charged: 1.265 corrected to 80ºF (26.7ºC)
Discharged: less than 1.240

Battery Specifications
BCI Group Size 26:
540 CCA at 0º F (–17.8º C)
Reserve Capacity of 80 minutes at 80ºF (26.7ºC)

Dimensions (including terminal posts and caps)

Length	8.2 inches (20.8 cm)
Width	6.8 inches (17.3 cm)
Height	8.0 inches (20.3 cm)

Removal (Fig. 41)

IMPORTANT: Be careful to not damage terminal posts or cable connectors when removing the battery cables.

1. Unlatch, raise and support hood. Loosen battery retainer securing the side of the battery to the frame.

2. Loosen nut on ground cable (–) first and remove ground cable from battery. This should prevent short circuiting the battery, other components or the operators hands.

3. Once negative cable has been disconnected from battery, loosen nut on positive cable (+) and remove positive cable from battery.

4. Make sure battery vent caps are on tightly.

5. Remove battery from the battery compartment to a service area to allow better access for service.

Inspection, Maintenance and Testing

1. Perform the following inspections and maintenance:

   A. Check for cracks. Replace battery if cracked or leaking.

   B. Check battery terminal posts for corrosion. Use wire brush to clean corrosion from posts.

IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.

   C. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling. Also, check battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.

   D. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

   E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water between the minimum and maximum fill lines. Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.

2. Conduct a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

   A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm–up the hydrometer. At the same time, take the temperature of the cell.

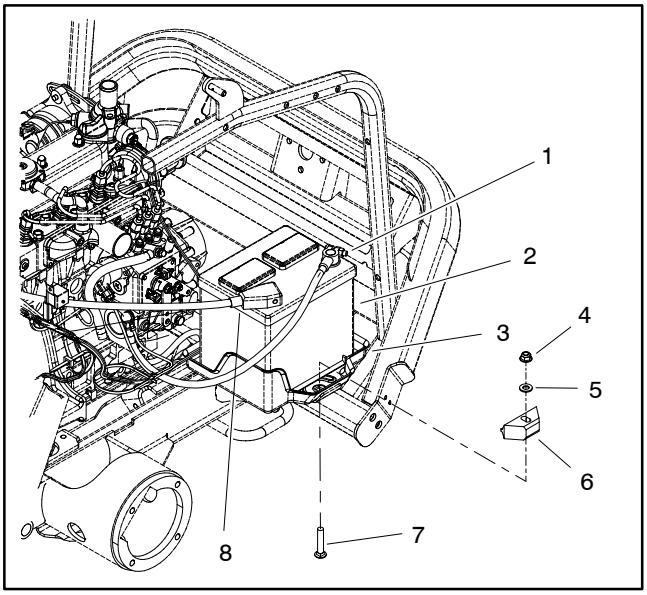

Figure 41

1. **Negative cable**
2. **Battery**
3. **Battery tray**
4. **Flange nut**
5. **Flat washer**
6. **Battery retainer**
7. **Carriage screw**
8. **Positive cable**

B. Temperature correct each cell reading. For each 10ºF (5.5ºC) above 80ºF (26.7ºC) add 0.004 to the specific gravity reading. For each 10ºF (5.5ºC) below 80ºF (26.7ºC) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature 100ºF
Cell Gravity 1.245
100ºF minus 80ºF equals 20ºF
(37.7ºC minus 26.7ºC equals 11.0ºC)
20ºF multiply by 0.004/10ºF equals 0.008
(11ºC multiply by 0.004/5.5ºC equals 0.008)
ADD (conversion above) 0.008
Correction to 80ºF (26.7ºC) 1.253

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

3. Perform a high–discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold–cranking test. A commercial battery load tester is **required** to perform this test.

CAUTION

Follow the manufacturer's instructions when using a battery tester.

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.4 VDC, charge the battery before proceeding with test.

B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

C. Make sure battery terminals are free of corrosion.

D. Measure the electrolyte temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of one half the Cranking Performance (see Battery Specifications) rating of the battery for 15 seconds.

G. Take the test voltage reading at 15 seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the center cell electrolyte temperature reading.

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70ºF (and up)	21.1ºC (and up)
9.5	60ºF	15.6ºC
9.4	50ºF	10.0ºC
9.3	40ºF	4.4ºC
9.1	30ºF	–1.1ºC
8.9	20ºF	–6.7ºC
8.7	10ºF	–12.2ºC
8.5	0ºF	–17.8ºC

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Installation (Fig. 41)

IMPORTANT: To prevent possible electrical problems, install only a fully charged battery.

1. Make sure ignition and all accessories are OFF.

2. Make sure battery compartment is clean and repainted if necessary. Place battery tray in position.

3. Make sure all battery cables, battery retainer and electrical connections are in good condition.

4. Place battery in its compartment. Make sure battery is level and flat. Connect positive (+) cable connector onto positive (+) battery post. Secure cable cap screw and lock nut using two wrenches.

5. Secure battery retainer with flat washer and flange nut. Do not overtighten to prevent cracking or distorting the battery case.

6. Connect a digital multimeter (set to amps) between the negative (–) battery post and the negative (–) cable connector. The reading should be less than 0.1 amp. A reading of more than 0.1 amp usually indicates a faulty switch, a shorted circuit or grounded wire. Identify and repair electrical faults before returning machine to service.

7. Connect negative (–) cable connector to the negative (–) battery post. Secure cable cap screw and lock nut using two wrenches.

8. After connections are made, apply battery terminal protector (Toro Part No. 107–0392) or a light coat of grease on all battery posts and cable connectors to reduce corrosion.

Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which should be available locally.

CAUTION

Follow the manufacturer's instructions when using a battery charger.

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its specific gravity or open circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the manufacturer's battery charger instructions** or the following table:

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	**3.8 hrs @ 3 amps**	**7.5 hrs @ 3 amps**	**11.3 hrs @ 3 amps**	**15 hrs @ 3 amps**
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15.5° C) before connecting to a charger.

Charge the battery in a well–ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. **Following the manufacturer's instructions**, connect the charger cables to the battery posts. Make sure a good connection is made.

4. Charge the battery **following the manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125°F (51.6°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three consecutive readings.

Chapter 6

Chassis

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Specifications

Item	Description
Rear tire pressure	15 PSI (103 kPa)
Castor wheel (front) tire pressure	25 PSI (172 kPa)
Tire pressure (machines with Polar Trac™)	30 PSI (103 kPa)
Rear wheel lug nut torque	75 to 85 ft–lb (102 to 115 N–m)
Wheel lug nut torque (machines with Polar Trac™)	65 to 85 ft–lb (88 to 115 N–m)
Rear wheel hub lock nut torque	300 to 400 ft–lb (407 to 502 N–m)

General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance procedures and maintenance intervals for your Groundsmaster machine. Refer to that publication for additional information when servicing the machine.

Rear Wheels

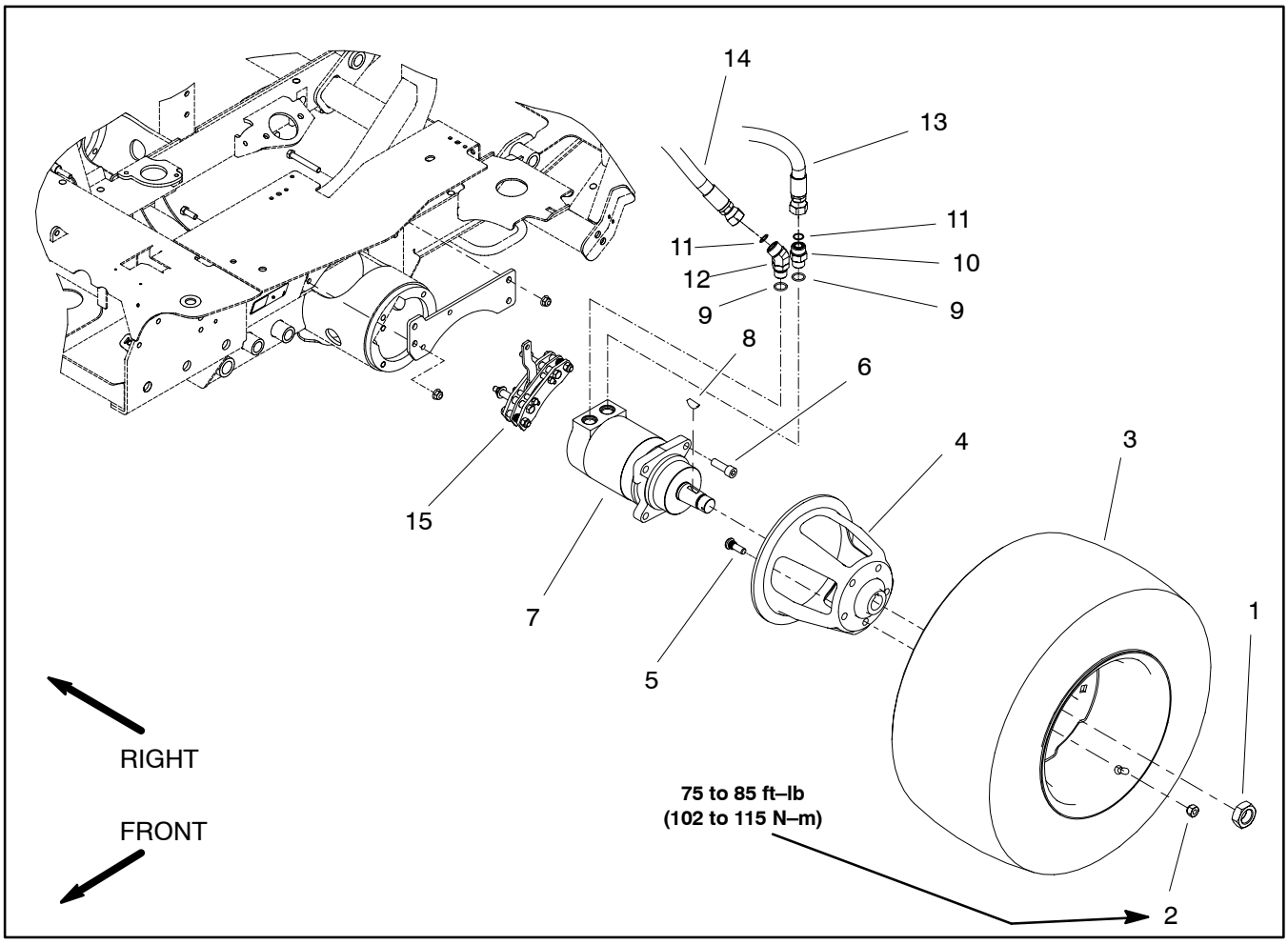

Figure 1

1. Lock nut
2. Lug nut (5 used per wheel)
3. Wheel assembly
4. Wheel hub
5. Wheel stud (5 used per wheel)
6. Socket head screw (4 used)
7. Wheel motor (LH shown)
8. Woodruff key
9. O–ring
10. Hydraulic fitting
11. O–ring
12. Hydraulic fitting
13. Hydraulic hose
14. Hydraulic hose
15. Parking brake (LH shown)

Removal (Fig. 1)

1. Park machine on a level surface, lower cutting deck (or implement), stop engine and remove key from the ignition switch.

NOTE: If machine is equipped with Polar Trac™ Kit, see Polar Trac™ Wheels in this section for information regarding wheel removal.

2. Loosen (but do not remove) lug nuts that secure rear wheel that is to be removed.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety. Do not support machine on rear wheel hubs (brake rotors).

3. Jack up rear wheel and use appropriate jack stands to support the machine.

4. Remove lug nuts from drive studs. Remove rear wheel from machine.

Installation (Fig. 1)

1. Secure wheel to machine with five (5) lug nuts.

2. Lower wheel to ground. Torque wheel lug nuts in a crossing pattern from **75 to 85 ft–lb (102 to 115 N–m)**.

Polar Trac™ Wheels

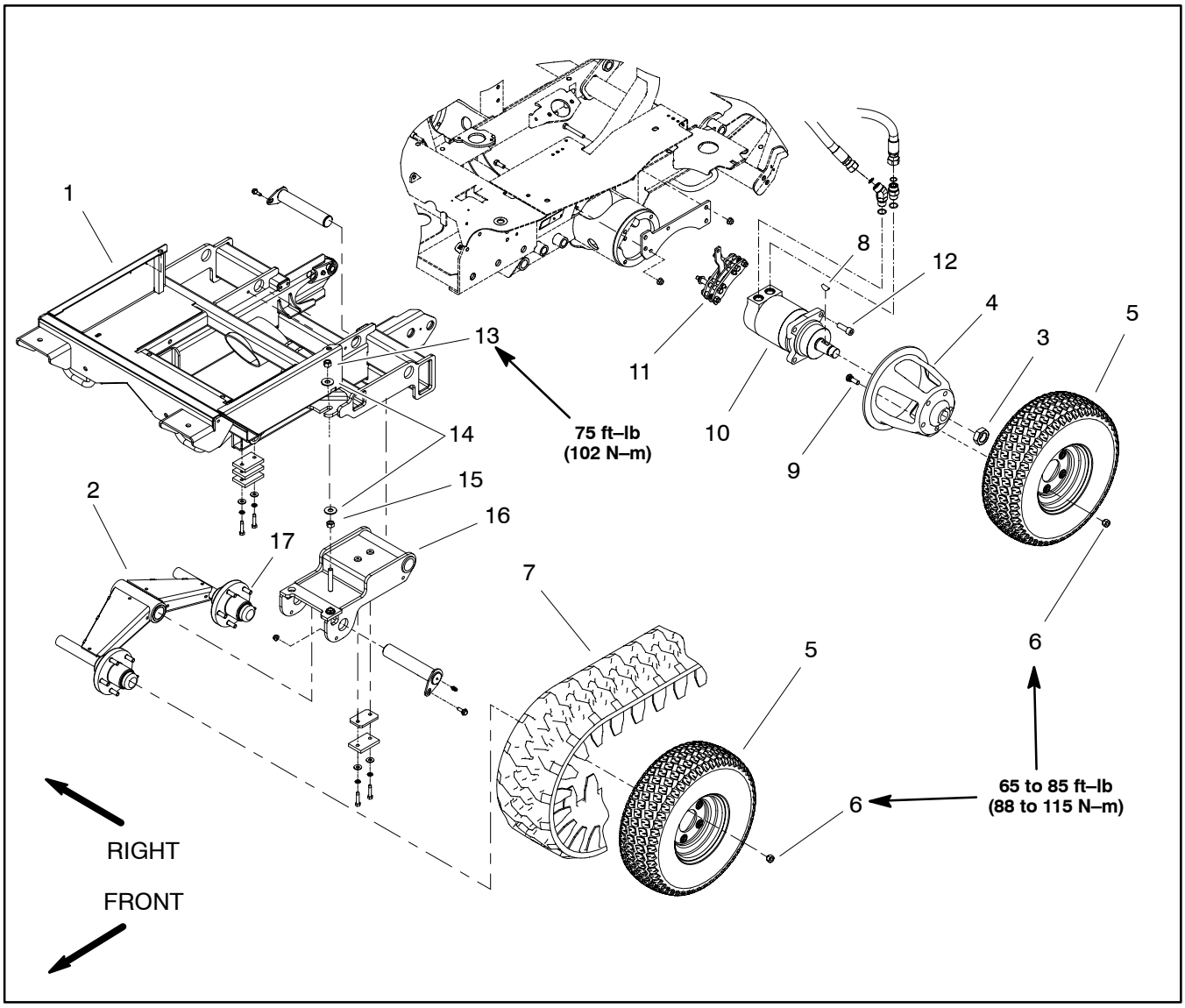

Figure 2

1. **Front frame**
2. **Bogie assembly**
3. **Lock nut**
4. **Rear wheel hub (LH shown)**
5. **Wheel assembly (6 used)**
6. **Lug nut (5 used per wheel)**
7. **Drive track**
8. **Woodruff key**
9. **Wheel stud (5 used per hub)**
10. **Rear wheel motor (LH shown)**
11. **Parking brake (LH shown)**
12. **Screw (4 used per motor)**
13. **Lock nut**
14. **Flat washer**
15. **Hex nut**
16. **Bogey pivot assembly (LH shown)**
17. **Wheel stud (5 used per hub)**

Removal (Fig. 2)

NOTE: Refer to the Polar Trac™ Operator's Manual for additional information regarding drive track and wheel removal.

1. Park machine on a level surface, lower implement, stop engine and remove key from the ignition switch.

NOTE: When removing wheels from a Polar Trac™ equipped machine, the center wheel must be removed first to allow track clearance for front or rear wheels.

2. Loosen (but do not remove) lug nuts that secure wheels that are to be removed.

3. Position two (2) jack stands under the rear bumper tube at a height so that they contact or nearly contact the bumper.

4. On the side of the machine that is to have the wheel(s) removed (Fig. 3):

   A. Remove two (2) screws securing the side access cover to the machine. Remove the access cover.

   B. Remove the lock nut and flat washer that secures the bogie pivot to the front frame.

5. Position a suitable floor jack under the center of the lift arm pivot tube.

6. Raise the front of the machine with the jack until the rear of the machine is supported on the jack stands and the center tire swings back and nearly contacts the rear tire. Support front of machine with jack stands.

CAUTION

The track guides have many pinch points. Carefully grasp the rubber track on the outer edges outboard of the steel guides when moving the tracks.

7. Have a second person lift the center of the track to allow removal of the center wheel. Remove lug nuts that secure center wheel to machine. Carefully remove center wheel from track and machine.

8. Once center wheel has been removed, have a second person lift the track from other wheel(s) as necessary to allow removal of additional wheel(s) from machine.

Installation (Fig. 2)

1. If the track was removed from the machine, position track to wheel location. Make sure that direction arrow on track is properly orientated.

NOTE: When installing wheels to a Polar Trac™ equipped machine, the center wheel must be installed last to allow track clearance for front and rear wheels.

2. Have a second person lift the track to allow installation of the front and/or rear wheel to machine. Secure wheel(s) to machine with five (5) lug nuts.

3. After front and rear wheels are installed on machine, have a second person lift the center of the track to allow installation of the center wheel. Secure center wheel to machine with five (5) lug nuts.

4. Lower the front of the machine to the ground.

NOTE: When securing bogey pivot to front frame, it may be necessary to raise rear of machine to allow installation of flat washer and lock nut.

5. Install flat washer (item 14) and then lock nut (item 13) to stud on bogey pivot. Secure pivot to front frame by torquing lock nut to **75 ft–lb (102 N–m)**.

6. Place side access cover to frame and secure with two (2) screws.

7. Fully lower machine to the ground. Torque all wheel lug nuts in a crossing pattern from **65 to 85 ft–lb (88 to 115 N–m)**.

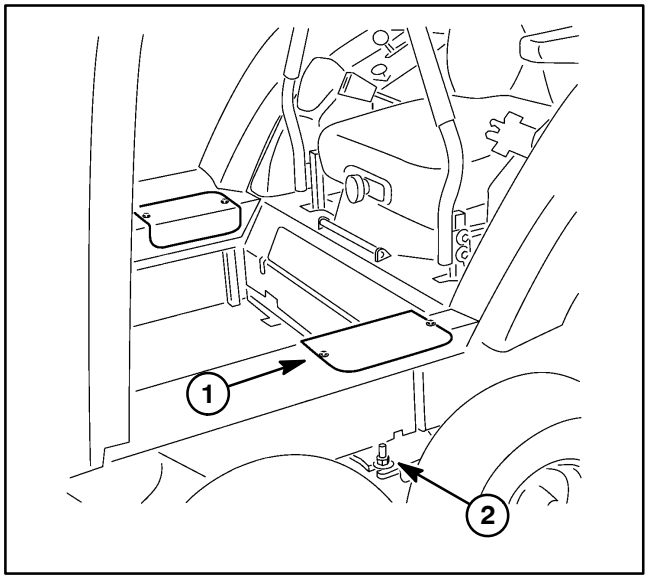

Figure 3

1. **Side access cover**
2. **Lock nut / flat washer**

Parking Brakes

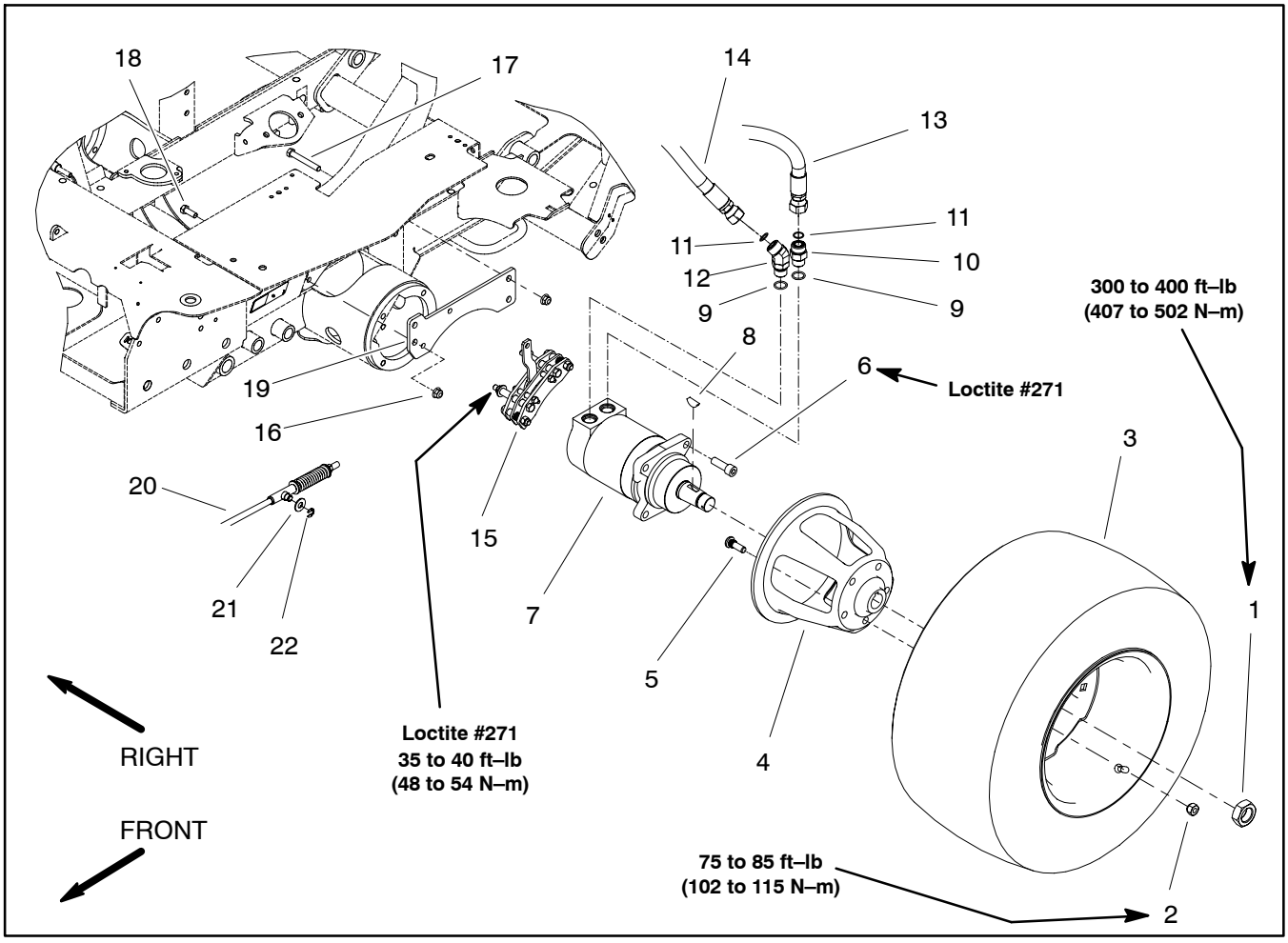

Figure 4

1. Lock nut
2. Lug nut (5 used per wheel)
3. Wheel assembly
4. Wheel hub
5. Wheel stud (5 used per wheel)
6. Socket head screw (4 used)
7. Wheel motor (LH shown)
8. Woodruff key
9. O–ring
10. Hydraulic fitting
11. O–ring
12. Hydraulic fitting
13. Hydraulic hose
14. Hydraulic hose
15. Parking brake (LH shown)
16. Flange nut (4 used per side)
17. Cap screw (2 used per side)
18. Cap screw (2 used per side)
19. Brake support
20. Brake rod assembly
21. Flat washer
22. Retaining ring

Removal (Fig. 4)

1. Park machine on a level surface, lower cutting deck (or implement), stop engine and remove key from the ignition switch.

NOTE: The installation torque of the lock nut used to secure wheel hub to wheel motor is from **300 to 400 ft–lb (407 to 542 N–m)**. If hub removal is necessary, use impact wrench to loosen lock nut.

2. If wheel hub is to be removed, loosen (but do not remove) lock nut that secures wheel hub to wheel motor.

3. Remove rear wheel (see Rear Wheel Removal in this section). Make sure that machine is properly supported with jack stands.

4. Remove retaining ring and flat washer that retains brake rod assembly to parking brake lever. Separate brake rod from brake lever.

5. Remove four (4) cap screws and flange nuts that secure brake support to frame.

6. Slide brake support (with parking brake assembly attached) from wheel hub disc and frame.

7. Remove two (2) lock nuts that secure parking brake assembly to brake support. Remove brake from support. Locate and retrieve two (2) hardened washers from between parking brake and brake support (Figs. 5 and 6).

IMPORTANT: If wheel hub removal is necessary, do not hit wheel hub or hub puller with a hammer during removal. Hammering may cause damage to the hydraulic wheel motor or wheel hub.

8. If necessary, use wheel hub puller to loosen wheel hub from the wheel motor shaft. Remove loosened lock nut and wheel hub from wheel motor. Remove woodruff key from the shaft.

Installation (Fig. 4)

1. If wheel hub was removed:

   A. Make sure that wheel hub and wheel motor shaft are cleaned thoroughly.

   B. Install key to the slot on the wheel motor shaft. Slide wheel hub onto the shaft.

   C. Secure wheel hub to the motor shaft with lock nut.

2. Place two (2) hardened washers on brake mounting screws (Figs. 5 and 6).

IMPORTANT: When installing brake to brake support, take care to not get Loctite on brake pad surface.

3. Apply Loctite #271 (or equivalent) to threads of brake mounting screws. Secure parking brake to brake support with two (2) lock nuts. Torque lock nuts from **35 to 40 ft–lb (48 to 54 N–m)**.

4. Place brake support (with parking brake assembly attached) to wheel hub disc and frame making sure that disc is between the two (2) stators (brake pads) in the brake assembly.

5. Place four (4) cap screws and flange nuts in mounting holes of brake support and frame but do not fully tighten.

6. Adjust position of brake support so that the clearance between the wheel hub disc and both springs in the parking brake (Fig. 7) is from **0.030" to 0.070" (0.8 to 1.7 mm)**. When clearance is correct, fully tighten fasteners.

7. Attach brake rod assembly to parking brake lever with flat washer and retaining ring.

8. Secure wheel to machine with five (5) lug nuts.

9. Lower wheel to ground. Torque wheel lug nuts in a crossing pattern from **75 to 85 ft–lb (102 to 115 N–m)**.

10. If wheel hub was removed, apply parking brake and torque lock nut (item 6) from **300 to 400 ft–lb (407 to 542 N–m)**. Release parking brake.

11. Check parking brake and brake switch operation.

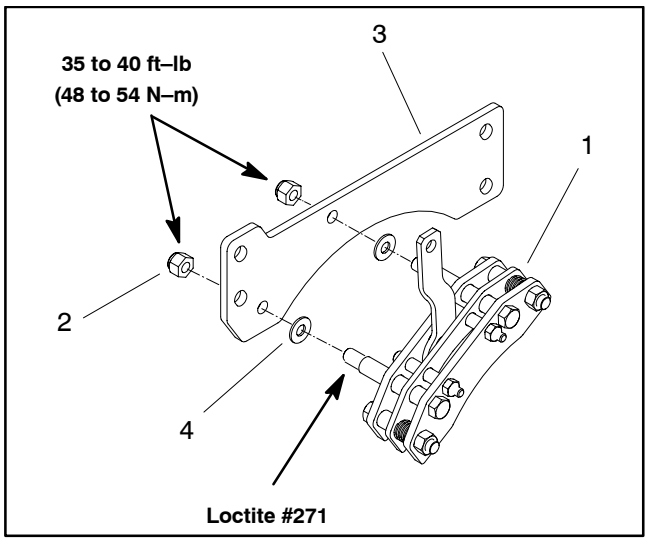

Figure 5

1. Parking brake assembly
2. Lock nut
3. Brake support
4. Hardened washer

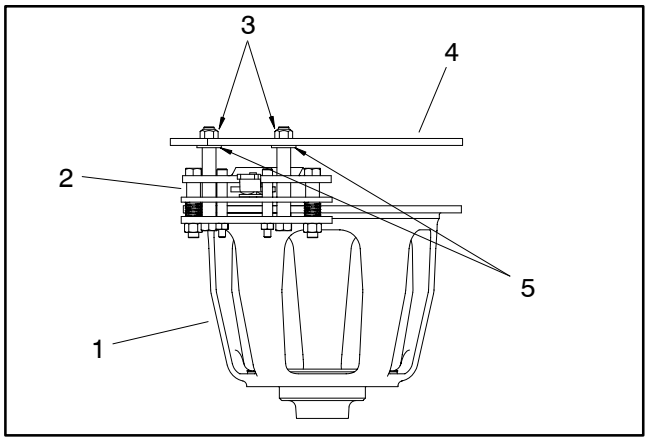

Figure 6

1. Wheel hub
2. Parking brake assembly
3. Lock nut
4. Brake support
5. Hardened washer

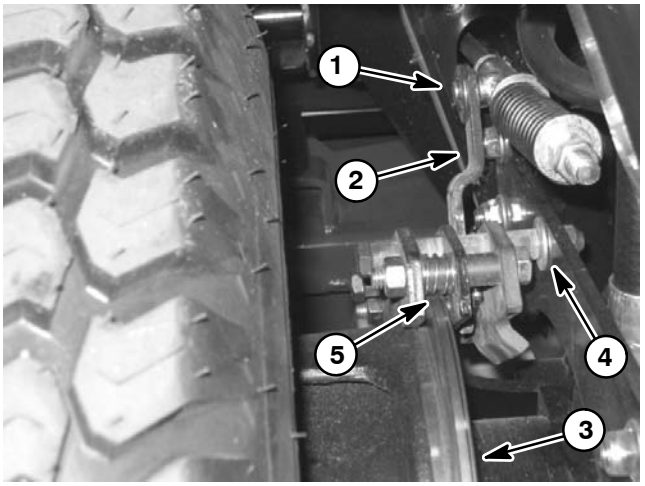

Figure 7

1. Brake swivel
2. Caliper brake lever
3. Wheel hub disc
4. Hardened washer
5. Clearance

Parking Brake Service

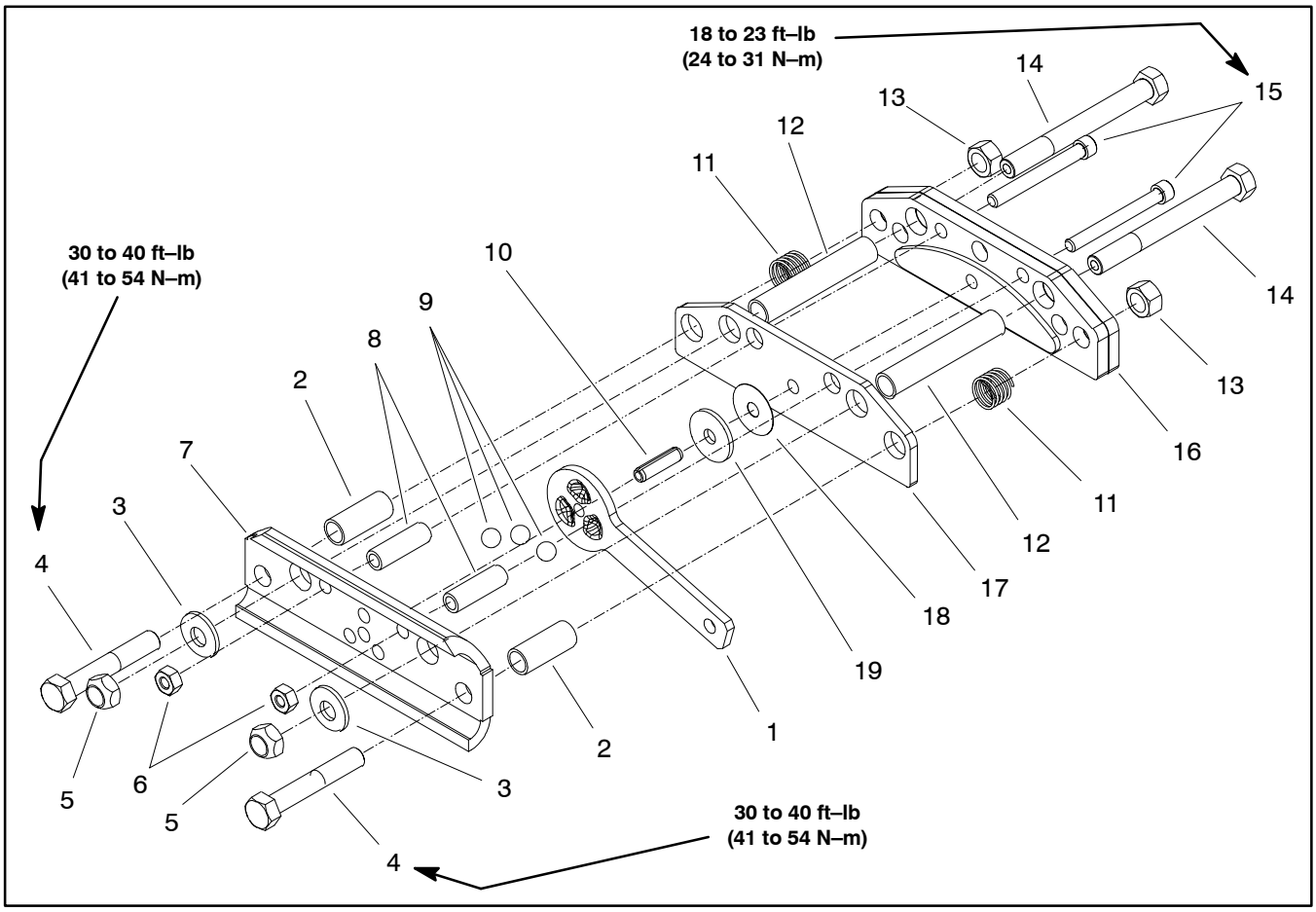

Figure 8

1. **Lever**
2. **Assembly sleeve (2 used)**
3. **Hardened washer (2 used)**
4. **Hex bolt (2 used)**
5. **Mounting lock nut (2 used)**
6. **Hex nut (2 used)**
7. **Stationary actuator**
8. **Sleeve (2 used)**
9. **Steel ball (3 used)**
10. **Spring pin**
11. **Compression spring (2 used)**
12. **Mount sleeve (2 used)**
13. **Hex nut (2 used)**
14. **Mounting screw (2 used)**
15. **Socket head screw (2 used)**
16. **Outer stator (brake pad)**
17. **Inner stator (brake pad)**
18. **Shim**
19. **Washer**

NOTE: If parking brake wear or damage occurs, brake replacement is necessary. Individual brake components are not available.

Disassembly (Fig. 8)

1. Loosen and remove hex bolts (item 4), socket head screws (item 15) and hex nuts (items 5 and 6).

2. Slide inner and outer stators from sleeves and stationary actuator.

3. Inspect parking brake components. Replace complete brake assembly if excessive wear or damage to any component is detected.

Assembly (Fig. 8)

1. Position stationary stator on level work surface.

2. Assemble brake components in order using Figure 8 as a guide.

3. Secure brake assembly with hex bolts (item 4), socket head screws (item 15) and hex nuts (items 5 and 6). Torque fasteners to values identified in Figure 8.

Parking Brake Assembly

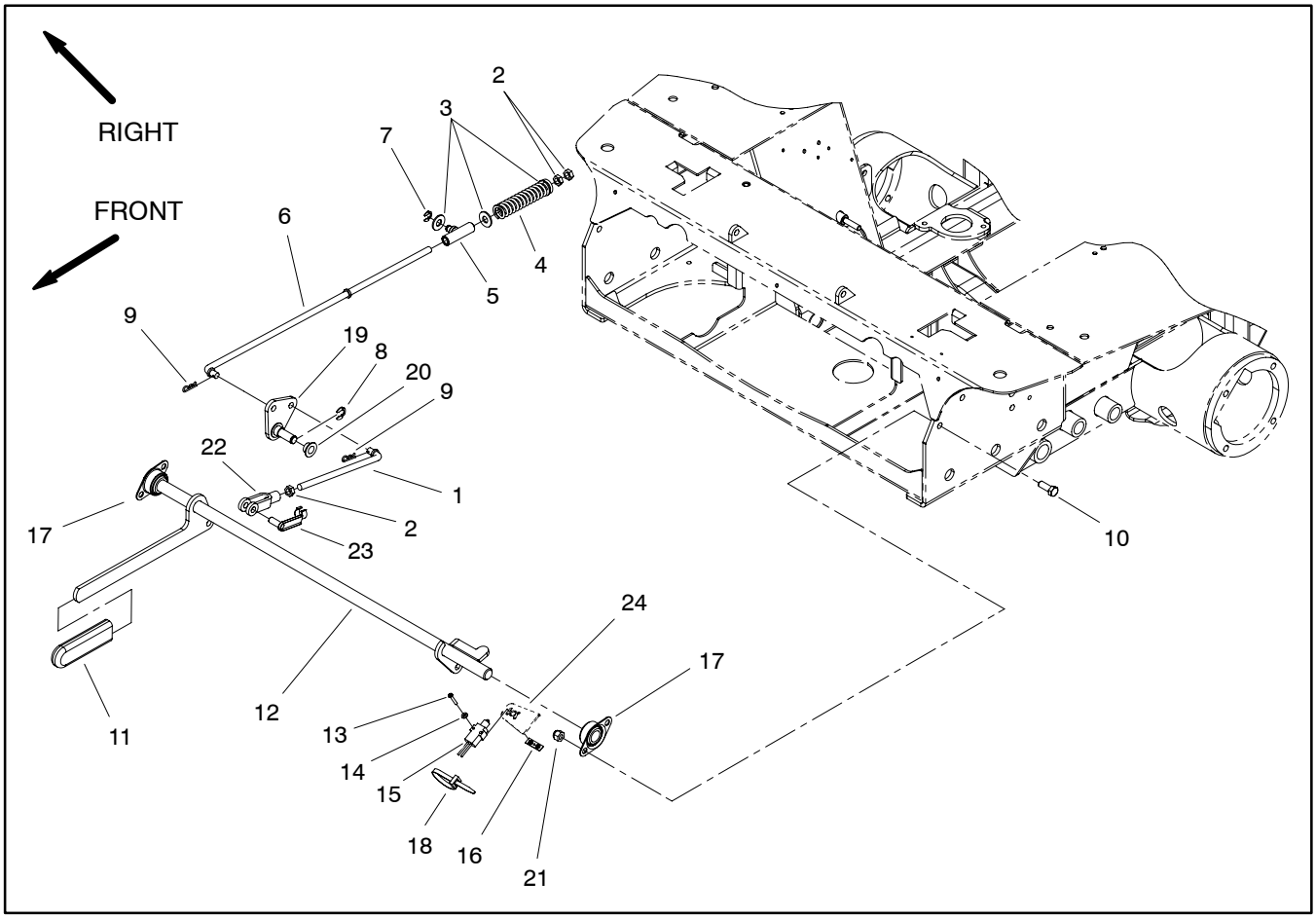

Figure 9

1. **Front brake rod (2 used)**
2. **Hex nut (6 used)**
3. **Flat washer (6 used)**
4. **Compression spring (2 used)**
5. **Swivel (2 used)**
6. **Rear brake rod (2 used)**
7. **Retaining ring (2 used)**
8. **Retaining ring (2 used)**
9. **Hair pin (4 used)**
10. **Cap screw (4 used)**
11. **Brake lever grip**
12. **Brake handle**
13. **Phillips head screw (2 used)**
14. **Flat washer (2 used)**
15. **Brake switch**
16. **Switch nut**
17. **Flange bearing (2 used)**
18. **Cable tie**
19. **Brake pivot (2 used)**
20. **Control bearing (4 used)**
21. **Lock nut (4 used)**
22. **Brake linkage yoke (2 used)**
23. **Clevis spring pin (2 used)**
24. **Frame bracket**

Disassembly (Fig. 9)

1. Park machine on a level surface, lower cutting deck (or implement), stop engine and remove key from the ignition switch.

2. Remove front panel under the operator seat (Fig. 10).

3. If removal of brake handle (item 12) is necessary:

   A. On both sides of machine, unlatch spring pin from brake linkage yoke. Remove spring pin from yoke and brake handle brackets.

   B. Support brake handle to prevent it from shifting or falling.

   C. Remove cap screws and lock nuts that secure flange bearings to frame.

   D. Remove brake handle and flange bearings from machine.

4. Remove additional parking brake components as necessary using Figure 9 as a guide.

Assembly (Fig. 9)

1. Assemble parking brake components as necessary using Figure 9 as a guide.

   A. If brake linkage yoke was removed from front brake rod, install yoke onto rod so that center to center length is from **8.290" to 8.350" (21.1 to 21.2 cm)** (Fig. 11).

   B. Make sure that cap screws (item 10) used to secure flange bearings (item 17) are installed from the outside of the frame to the inside.

2. After assembly of brake system, apply parking brake and check length of compression spring on rear brake rod. Spring length with brake applied should be from **2.880" to 3.000" (7.4 to 7.6 cm)** (Fig. 12). If necessary, adjust spring length with hex nuts on rear of brake rod.

3. Check operation of parking brake and parking brake switch.

4. Install front panel to the machine (Fig. 10).

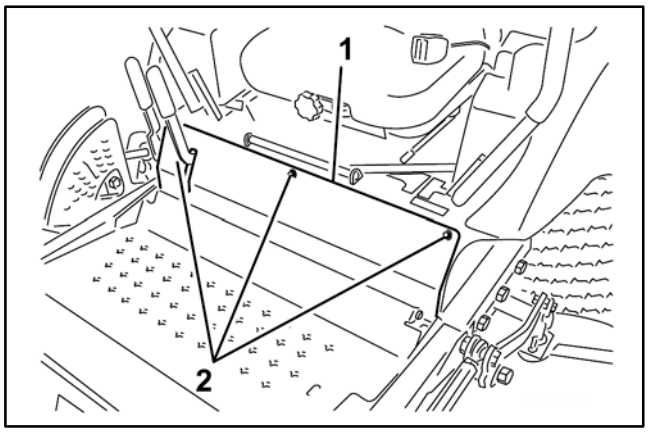

Figure 10

1. **Front panel**
2. **Washer head screw**

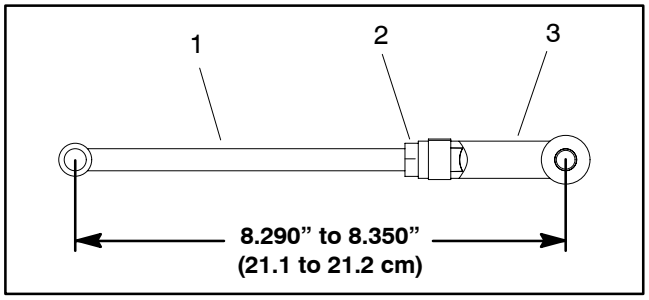

Figure 11

1. **Front brake rod**
2. **Hex nut**
3. **Brake linkage yoke**

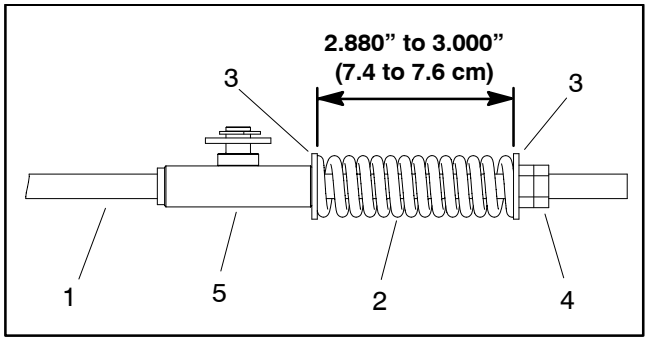

Figure 12

1. **Rear brake rod**
2. **Compression spring**
3. **Flat washer**
4. **Hex nut (2 used)**
5. **Swivel**

Front Castor Wheels

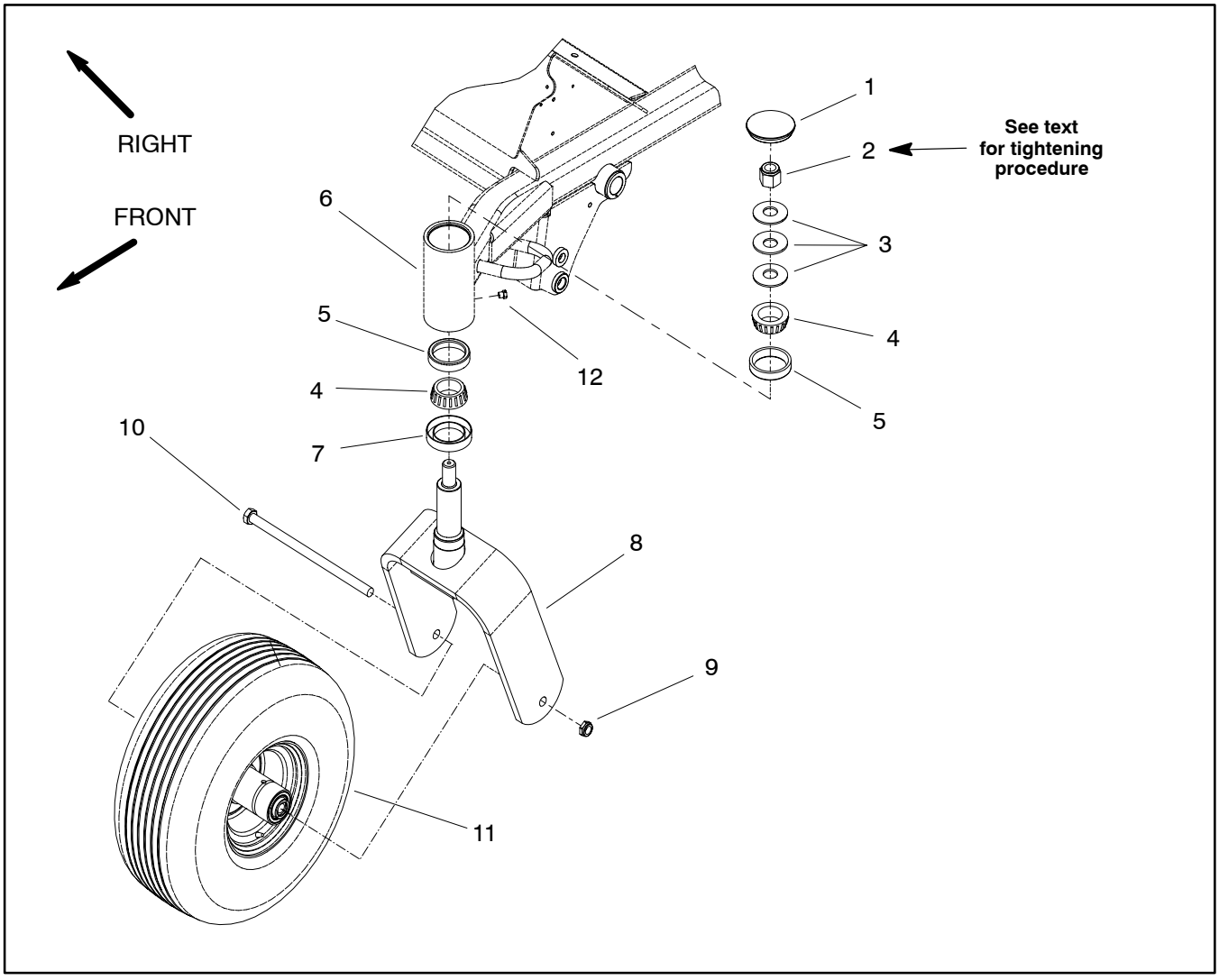

Figure 13

1. **Grease cap**
2. **Lock nut**
3. **Belleville washer**
4. **Bearing cone**
5. **Bearing cup**
6. **Carrier frame**
7. **Seal**
8. **Castor fork**
9. **Lock nut**
10. **Cap screw**
11. **Castor wheel assembly**
12. **Plug**

Disassembly (Fig. 13)

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Chock wheels. Jack front of machine enough to allow the removal of the castor wheel. Support machine with appropriate jack stands.

3. Remove cap screw and lock nut that secure castor wheel to castor fork. Remove castor wheel assembly from machine.

4. Remove grease cap (item 1) from carrier frame. Discard cap.

5. Support castor fork to prevent it from falling. Remove lock nut from castor fork. Slide castor fork from machine.

6. Remove three (3) belleville washers and upper bearing cone from carrier frame. Note orientation of washers as they are removed (Fig. 14). Belleville washer orientation is critical for proper castor wheel movement.

7. Pry seal from carrier frame. Discard seal. Remove lower bearing cone from frame.

8. Inspect bearing cups in carrier frame for wear or damage. If bearing cups are damaged, remove bearing cups from frame and replace.

9. If necessary, remove spacers, seals and bearings from castor wheel using Figure 15 as a guide. Inspect and replace all wheel components that show signs of wear or damage.

Assembly (Fig. 13)

1. If components were removed from castor wheel, assemble castor wheel (Fig. 15):

   A. Press bearing cups into castor wheel until they are flush with shoulder in wheel.

   B. Install grease packed bearing cone into wheel.

   C. Install seals into wheel.

   D. Carefully fit bearing spacers and then castor spacer into wheel.

2. If bearing cups were removed from carrier frame, press new cups into carrier frame until they are flush with shoulder in frame.

3. Pack both bearing cones with new grease. Place grease packed bearing cone into lower bearing cup of carrier frame. Install new seal.

4. Slide castor fork up through carrier frame taking care to not damage seal. Position grease packed bearing cone onto castor fork. Place three (3) belleville washers onto castor fork noting orientation shown in Figure 14.

IMPORTANT: After correctly tightening the lock nut that secures castor fork to carrier frame, it should take from 70 to 80 in–lb (7.9 to 9.0 N–m) to rotate the castor fork.

5. Install lock nut onto castor fork. Tighten lock nut until castor fork requires from **70 to 80 in–lb (7.9 to 9.0 N–m)** to rotate.

6. Remove plug (item 12) from carrier frame. Using grease gun through plug hole in frame, fill area surrounding the castor fork shaft with grease. Allow grease to fill cavities below lower bearing, between bearings and above upper bearing. Reinstall plug into frame.

NOTE: Periodic greasing of castor fork bearing area is not necessary. Do not replace plug (item 12) with grease fitting. Grease cap (item 1) will loosen if castor fork has excessive grease installed.

7. Install new grease cap (item 1) so cap shoulder is flush with top of carrier frame. There should be no evidence that the cap is indented by top of castor fork.

8. Position castor wheel to castor fork and secure with cap screw and lock nut.

9. Lower machine to ground.

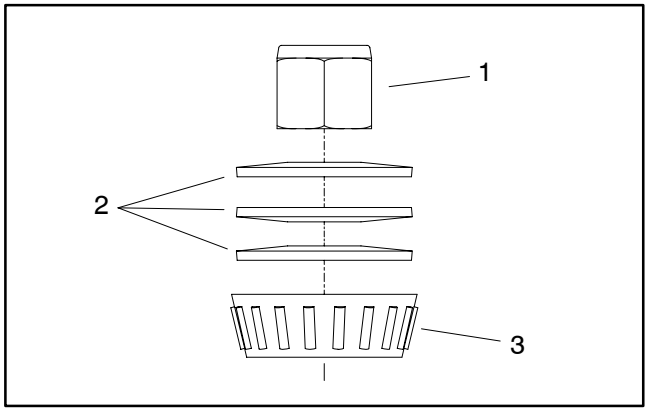

Figure 14

1. **Lock nut**
2. **Belleville washer**
3. **Upper bearing cone**

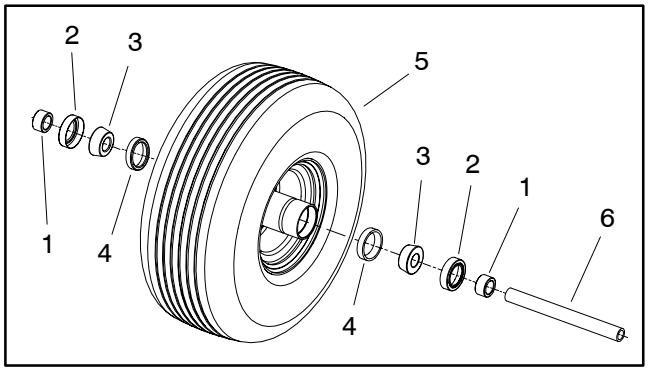

Figure 15

1. **Bearing spacer**
2. **Seal**
3. **Bearing cone**
4. **Bearing cup**
5. **Castor wheel**
6. **Castor spacer**

Polar Trac™ Wheel Hub Service

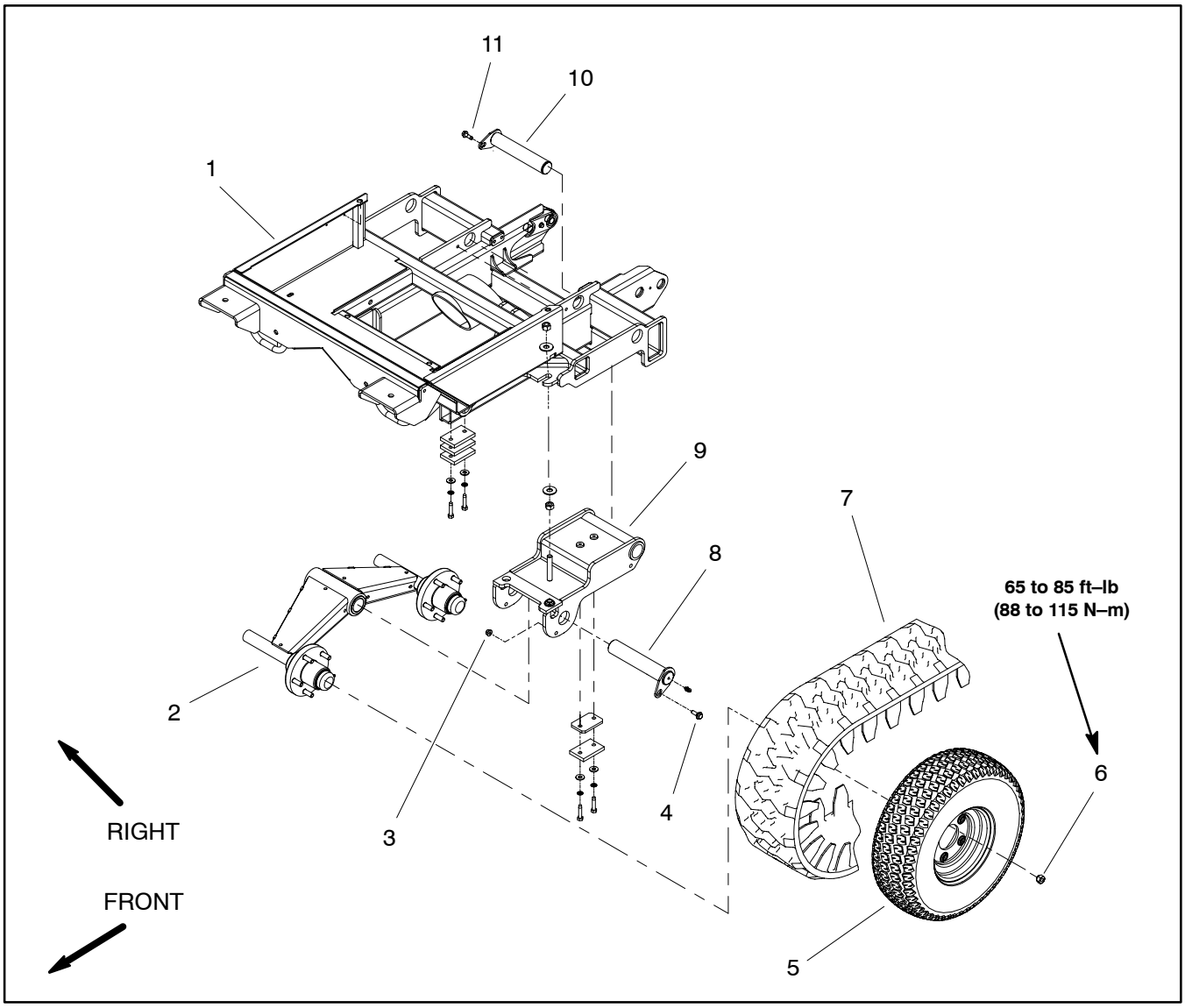

Figure 16

1. **Frame**
2. **Bogie assembly**
3. **Flange nut**
4. **Shoulder screw**
5. **Wheel assembly**
6. **Lug nut (5 used per wheel)**
7. **Drive track**
8. **Pivot pin**
9. **Pivot (LH shown)**
10. **Pivot pin**
11. **Shoulder bolt**

Disassembly (Figs. 16 and 17)

NOTE: Refer to the Polar Trac™ Operator's Manual for additional information regarding drive track and wheel removal.

1. Park machine on a level surface, lower implement, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove wheels as needed to gain access to wheel hub(s) (see Polar Trac™ Wheels Removal in this section).

3. Make sure that machine is supported with jack stands.

4. Remove the dust cap from the wheel hub.

5. Remove the cotter pin and slotted hex nut. Slide the wheel hub with bearings from the spindle shaft.

6. Remove the seal from the wheel hub. Discard seal.

7. Remove the bearing cones from both sides of the wheel hub.

8. Clean the bearings in solvent. Make sure the bearings are in good operating condition. Clean the inside of the wheel hub. Check the bearing cups for wear, pitting or other damage. Replace all worn or damaged parts.

Assembly (Figs. 16 and 17)

1. If bearing cups were removed from the wheel hub, press new cups into the hub until they seat against the shoulder of the hub.

IMPORTANT: The lip of the seal must be toward the bearing. The seal should be pressed in so it is flush with the end of the wheel hub.

2. Pack both bearings with grease. Install one bearing into the bearing cup on inboard side of the wheel hub. Lubricate the inside of a new seal and press it into the wheel hub with the seal lip toward the bearing.

3. Fill wheel hub cavity between bearings approximately 50% full of grease. Position remaining bearing into the outer bearing cup.

4. Slide the wheel hub assembly onto the spindle shaft and secure it in place with the slotted hex nut. DO NOT fully tighten the nut or install the cotter pin.

5. While rotating the wheel hub by hand, torque the slotted hex nut from 75 to 100 in–lb (8.5 to 11.3 N–m) to set the bearings. Then, loosen the nut until the hub has endplay.

6. While rotating the wheel hub by hand, torque the slotted hex nut from **15 to 20 in–lb (1.7 to 2.3 N–m)** while aligning hex nut slot with shaft hole. After tightening, make sure that the wheel hub does not have any free play.

7. Install cotter pin.

8. Install dust cap.

9. Install drive track and wheels to machine. (see Polar Trac™ Wheels Installation in this section). Make sure that drive track is installed in the correct direction of rotation.

10. Lower machine to ground.

11. Torque all removed lug nuts evenly in a crossing pattern from **65 to 85 ft–lb (88 to 115 N–m)**.

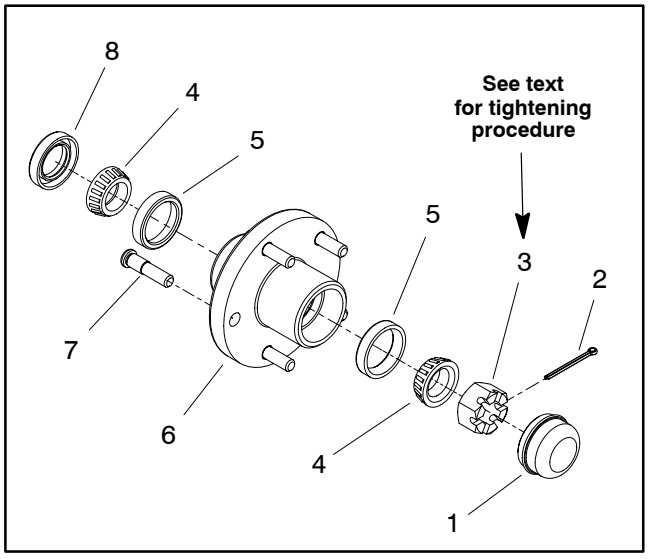

Figure 17

1. **Dust cap**
2. **Cotter pin**
3. **Slotted hex nut**
4. **Bearing cone**
5. **Bearing cup**
6. **Wheel hub**
7. **Wheel stud (5 used)**
8. **Seal**

PTO Drive Shaft

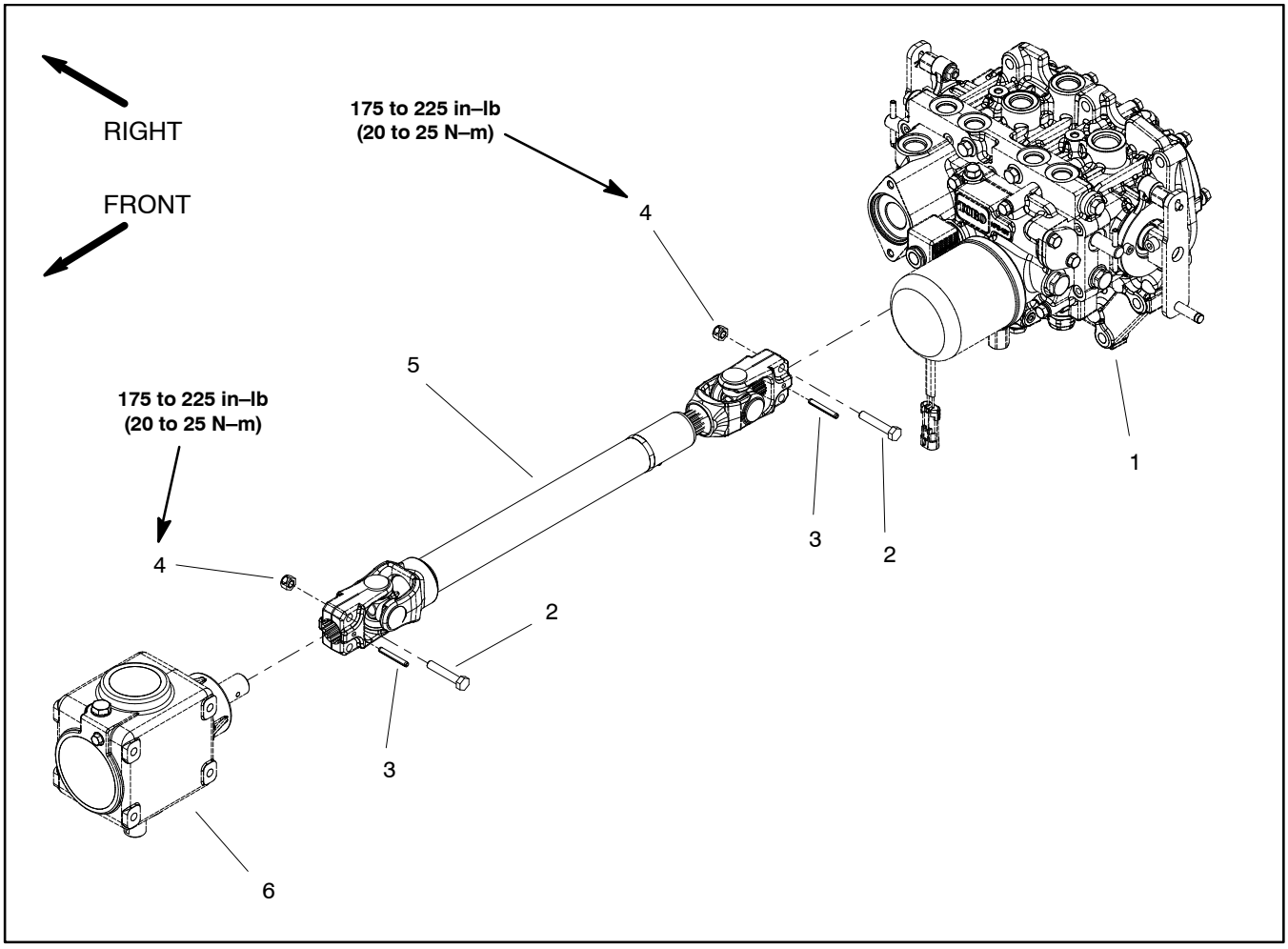

Figure 18

1. Transmission assembly
2. Cap screw (4 used)
3. Roll pin (2 used)
4. Lock nut (4 used)
5. PTO drive shaft
6. Cutting deck gearbox

WARNING

Do not start the engine and engage the PTO switch when the PTO drive shaft is disconnected from the cutting deck (or implement). If the engine is started and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result. If the PTO drive shaft is disconnected from the cutting deck (or implement), remove fuse F1 (15 amp) from fuse block to prevent unintentional engagement of the PTO clutch.

Removal (Fig. 18)

NOTE: PTO drive shaft removal is easier if machine is positioned on a hoist.

1. Park machine on a level surface, lower cutting deck (or implement) to lowest setting, stop engine, engage parking brake and remove key from the ignition switch.

2. To prevent unintentional engagement of the PTO clutch, remove fuse F1 (15 amp) from fuse block.

3. Disconnect end yoke of PTO drive shaft from PTO shaft on transmission:

   A. Remove roll pin from end yoke and PTO shaft.

   B. Loosen two (2) cap screws and lock nuts.

   C. Slide drive shaft end yoke from PTO shaft.

4. Disconnect end yoke of PTO drive shaft from cutting deck gearbox shaft:

   A. Remove roll pin from end yoke and gearbox shaft.

   B. Loosen two (2) cap screws and lock nuts.

   C. Slide drive shaft end yoke from gearbox shaft.

5. Remove PTO drive shaft from machine.

Installation (Fig. 18)

1. Position PTO drive shaft to machine. Make sure that drive shaft slip shaft yoke (item 4 in Fig. 19) is toward cutting deck gearbox shaft.

2. Align splines and roll pin holes of drive shaft yokes with transmission and gearbox shafts.

3. Slide PTO drive shaft end yokes onto transmission PTO shaft and gearbox shaft.

4. Secure end yokes of PTO drive shaft.

   A. Install roll pins in end yokes and shafts.

   B. Tighten lock nuts to secure end yokes to gearbox shaft and PTO shaft. Torque lock nuts from **175 to 225 in–lb (20 to 25 N–m)**.

5. Lubricate PTO drive shaft grease fittings.

6. Install fuse F1 (15 amp) into fuse block.

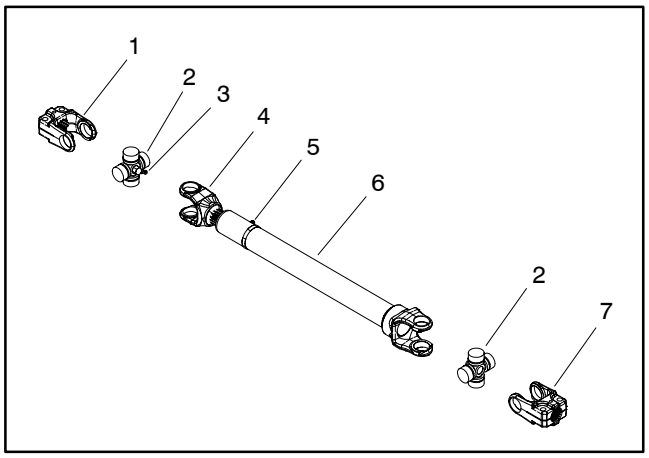

Figure 19

1. **End yoke**
2. **Cross and bearing set**
3. **Grease fitting**
4. **Slip yoke shaft**
5. **Grease fitting**
6. **Slip yoke tube**
7. **End yoke**

PTO Drive Shaft Cross and Bearing Service

1. Remove PTO drive shaft from vehicle (see PTO Drive Shaft Removal in this section).

IMPORTANT: When placing yoke in vise, clamp lightly on the solid part of the yoke to prevent yoke damage. Also, the use of a vise with soft jaws is recommended.

2. Lightly clamp yoke in vise. Use two screwdrivers to remove snap rings that secure bearings at the inside of each yoke. Remove yoke from vise.

IMPORTANT: Yokes must be supported when removing and installing bearings to prevent damage.

3. Use a press to remove cross and bearings from yokes:

A. Place a small socket against one bearing and a large socket against the yoke on the opposite side.

B. While supporting the large socket, apply pressure on small socket to partially push the opposite bearing into the large socket.

C. Remove yoke from press, grasp partially removed bearing and tap on yoke to completely remove the bearing.

D. Repeat process for remaining bearings.

E. Thoroughly clean and inspect all components.

4. To install new cross and bearings:

A. Apply a coating of grease to bearing bores of end yoke and shaft yoke. Also, apply grease to bearings and seal of bearing assembly. Make sure that all bearing rollers are properly seated in bearing cage.

B. Press one bearing partially into yoke.

IMPORTANT: Take care when installing cross into bearing to avoid damaging bearing seal.

C. Carefully insert cross into bearing and yoke.

D. Hold cross in alignment and press bearing in until it hits the yoke.

E. Carefully place second bearing into yoke bore and onto cross shaft. Press bearing into yoke.

F. Install snap rings to bearings to secure bearings in place.

G. Repeat procedure for other yoke.

H. Grease cross until grease comes out of all four (4) bearing cups.

5. Make sure that assembled joint moves without binding. Slight binding can usually be eliminated by lightly rapping the yoke lugs with a soft faced hammer. If binding continues, disassemble joint to identify source of binding.

6. Install drive shaft to vehicle (see PTO Drive Shaft Installation in this section).

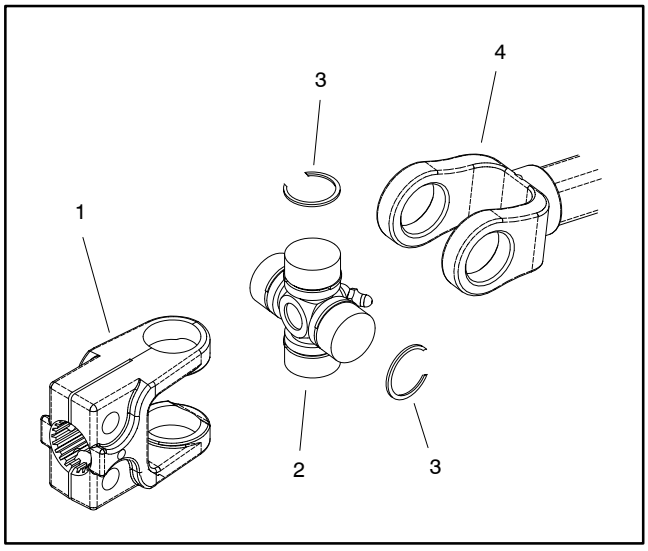

Figure 20

1. **End yoke**
2. **Cross and bearing kit**
3. **Snap ring (4 used)**
4. **Shaft yoke**

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Cutting Deck Lift Arms

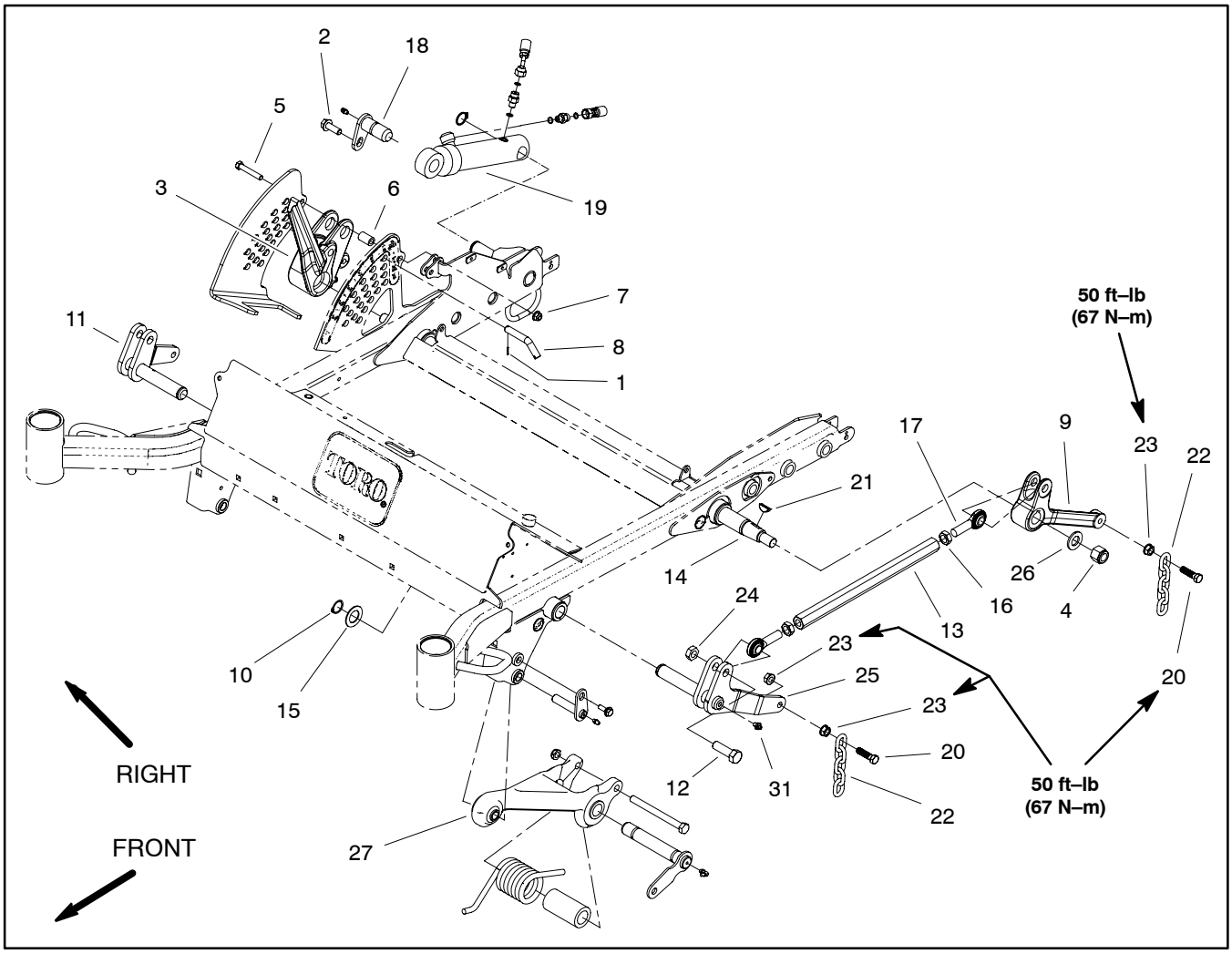

Figure 21

1. Roll pin
2. Flange head screw
3. RH rear lift arm
4. Lock nut (2 used)
5. Cap screw
6. Spacer
7. Flange nut (2 used)
8. Height of cut pin
9. LH rear lift arm
10. Retaining ring (2 used)
11. RH front lift arm
12. Cap screw (4 used)
13. Link (2 used)
14. Deck lift shaft
15. Washer (2 used)
16. Jam nut (1 used per ball joint)
17. Ball joint (4 used)
18. Pivot pin
19. Lift cylinder
20. Cap screw (4 used)
21. Woodruff key (2 used)
22. Deck lift chain (4 used)
23. Flange nut (6 used)
24. Lock nut (3 used)
25. LH front lift arm
26. Washer (2 used)
27. Pull link assembly (2 used)

Disassembly (Fig. 21)

1. Park machine on a level surface with the cutting deck in the **fully raised** position. Stop engine, engage parking brake and remove key from the ignition switch.

2. Note location of HOC pin in HOC bracket for assembly purposes (Fig. 22). Remove HOC pin from HOC bracket.

3. Start engine and fully lower cutting deck. Stop engine and remove key from the ignition switch.

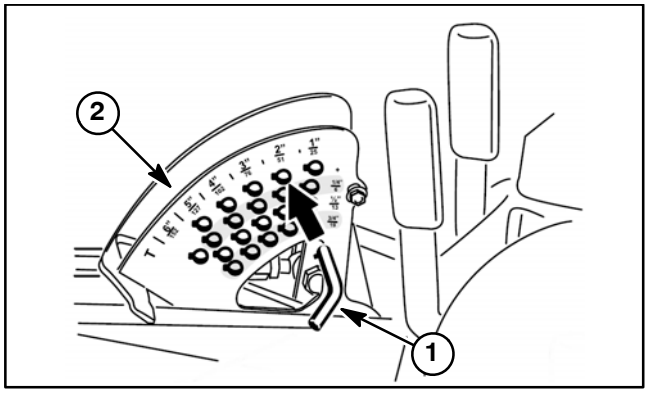

Figure 22

1. HOC pin
2. HOC bracket

4. Remove lift arm components as necessary using Figures 21 and 23 as guides.

NOTE: If pull link assembly (item 27) removal is necessary, refer to Cutting Deck Pull Links in the Service and Repairs section of Chapter 7 – Cutting Deck.

Assembly (Fig. 21)

1. Check flange bushing(s) in carrier frame for wear or damage (Fig. 24). Replace flange bushing(s) if necessary.

2. Install lift arm components as necessary using Figures 21 and 23 as guides.

A. If rear lift arm was removed from deck lift shaft, make sure to thoroughly clean tapers of shaft and lift arm bore before installing lift arm to shaft. Also, when installing washer (item 26), position washer cavity toward lift arm (Fig. 25).

B. If ball joints were removed from link (item 13), install ball joints equally on both ends of link. Adjust center to center length of link assembly from **18.070" to 18.180" (45.9 to 46.1 cm)** (Fig. 26). Tighten jam nuts to secure ball joints to link. Make sure that ball joints stay inline when tightening jam nuts.

NOTE: Do not change the link assembly length to adjust the height–of–cut or for any other reason.

NOTE: When properly installed, flange nuts (item 23) should have flange surface against lift arm and not against chain.

C. If cap screw (item 20) was removed from chain (item 22), insert screw into upper link of chain and thread flange nut (item 23) onto screw with flange away from link. Torque flange nut to **50 ft–lb (67 N–m)**. When fastening chain to front lift arm, torque second flange nut to **50 ft–lb (67 N–m)**. When installing chain to rear lift arm, torque cap screw to **50 ft–lb (67 N–m)**.

3. Lubricate all lift arm grease fittings after assembly.

4. Start engine and fully raise cutting deck. Stop engine and remove key from the ignition switch. Install HOC pin into HOC bracket to allow desired height–of–cut (Fig. 22).

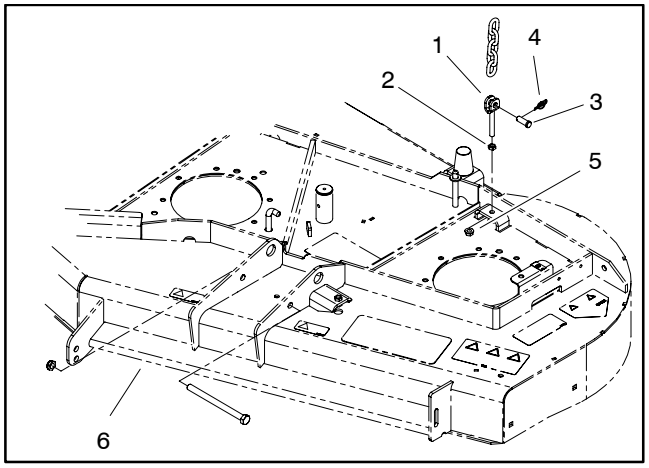

Figure 23

1. **Adjustment clevis**
2. **Jam nut**
3. **Clevis pin**
4. **Ring pin**
5. **Flange nut**
6. **Cutting deck**

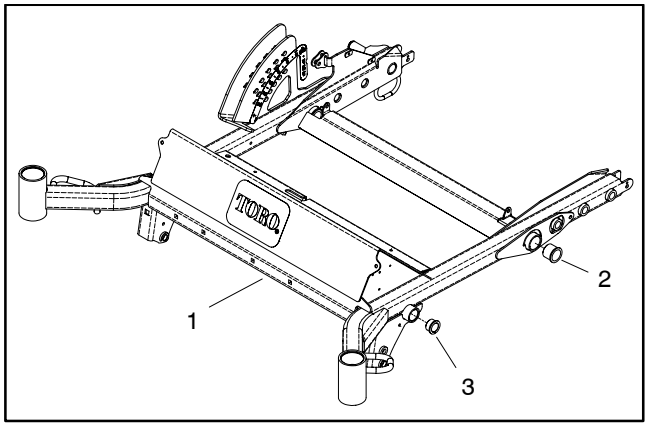

Figure 24

1. **Carrier frame**
2. **Flange bushing (2 used)**
3. **Flange bushing (2 used)**

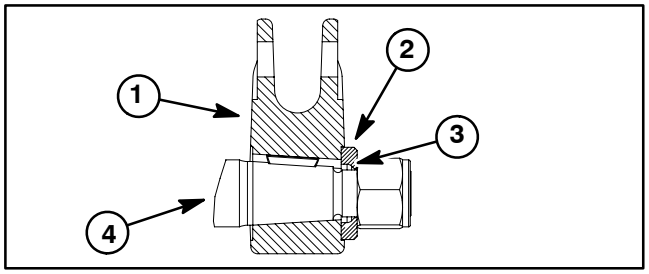

Figure 25

1. **Rear lift arm**
2. **Washer**
3. **Washer cavity**
4. **Deck lift shaft**

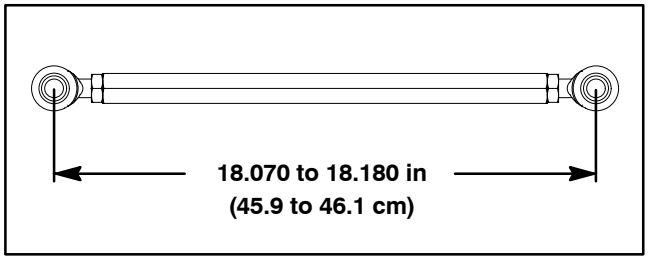

Figure 26

Operator Seat

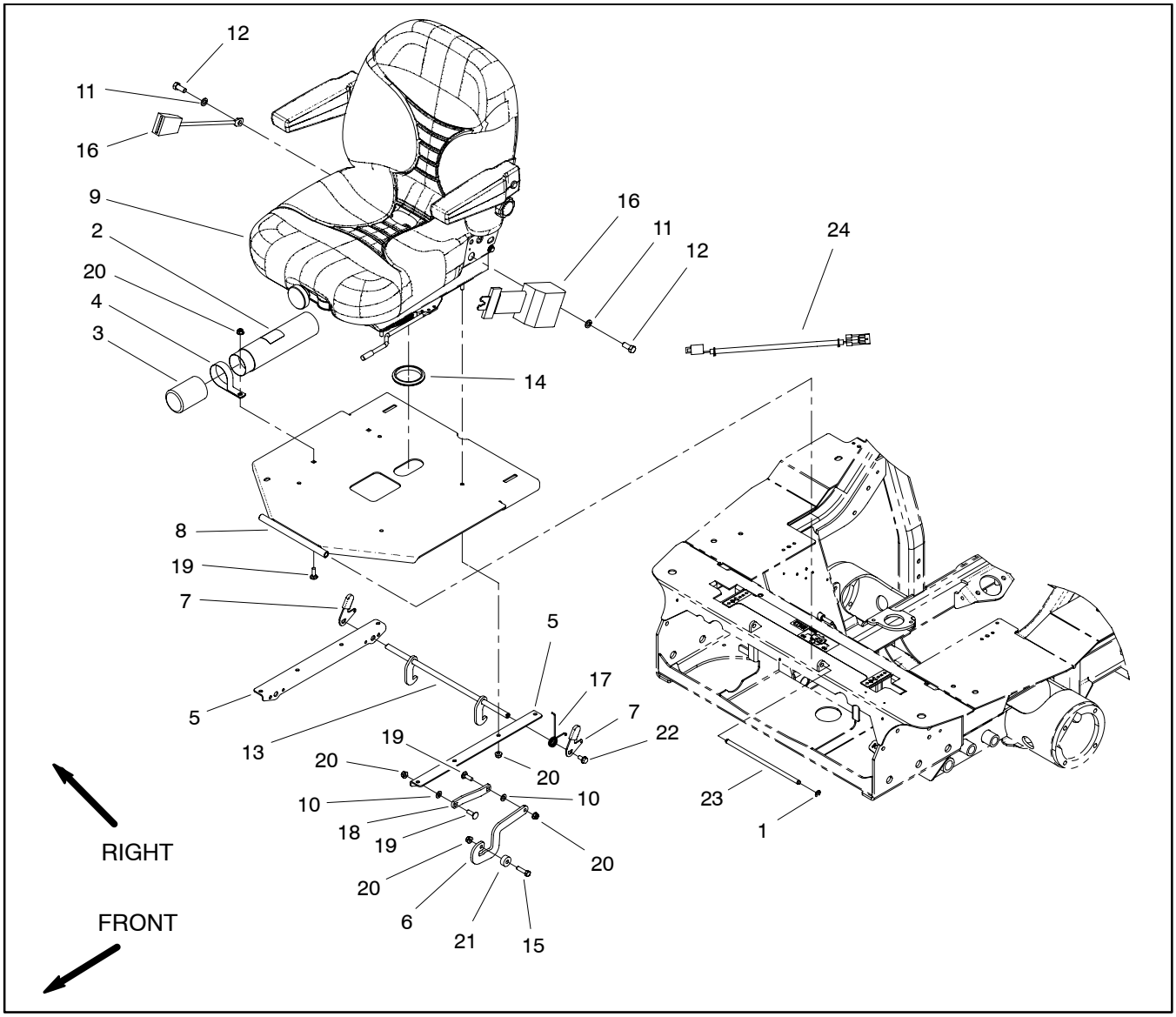

Figure 27

1. **E–ring (2 used)**
2. **Manual housing**
3. **Housing cap**
4. **R–clamp (2 used)**
5. **Latch angle (2 used)**
6. **Seat stop lever**
7. **Latch lever (2 used)**
8. **Seat plate**
9. **Operator seat**
10. **Flat washer (2 used)**
11. **Lock washer (2 used)**
12. **Cap screw (2 used)**
13. **Latch**
14. **Grommet**
15. **Cap screw**
16. **Seat belt**
17. **Torsion spring**
18. **Seat link**
19. **Carriage bolt (4 used)**
20. **Flange nut (9 used)**
21. **Spacer**
22. **Washer head screw (2 used)**
23. **Clevis pin**
24. **Seat switch harness**

Removal (Fig. 27)

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Unlatch and raise operator seat.

WARNING

If seat switch service is necessary, remove seat from seat plate to access switch. To prevent injury, DO NOT attempt to reach switch through openings in seat plate.

3. Disconnect machine wire harness electrical connector from the seat switch harness connector (Fig. 28).

4. Support seat and latch angles to prevent them from shifting during seat removal.

5. Remove four (4) flange nuts that secure seat and latch angles to seat plate. Remove seat from machine.

6. Remove seat parts as necessary using Figure 27 as a guide.

Installation (Fig. 27)

1. Install all removed seat parts using Figure 27 as a guide.

2. Position seat and latch angles to seat plate. Secure assembly with four (4) flange nuts.

3. Connect wire harness electrical connector to the seat switch harness (Fig. 28).

4. Lower and latch seat.

5. Check operation of operator seat switch.

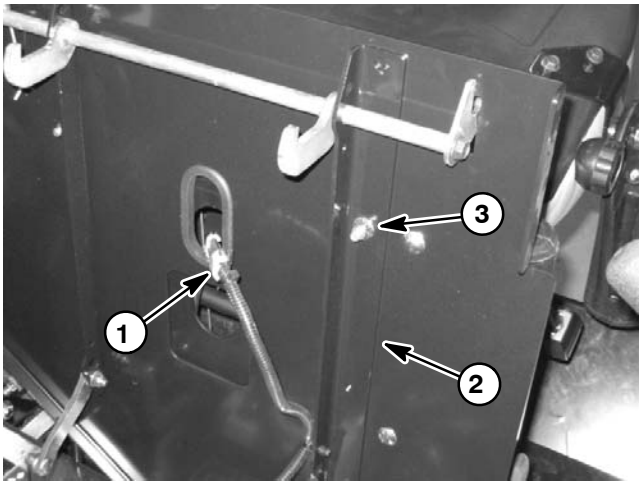

Figure 28

1. **Harness connector**
2. **Latch angle**
3. **Flange nut**

Operator Seat Service

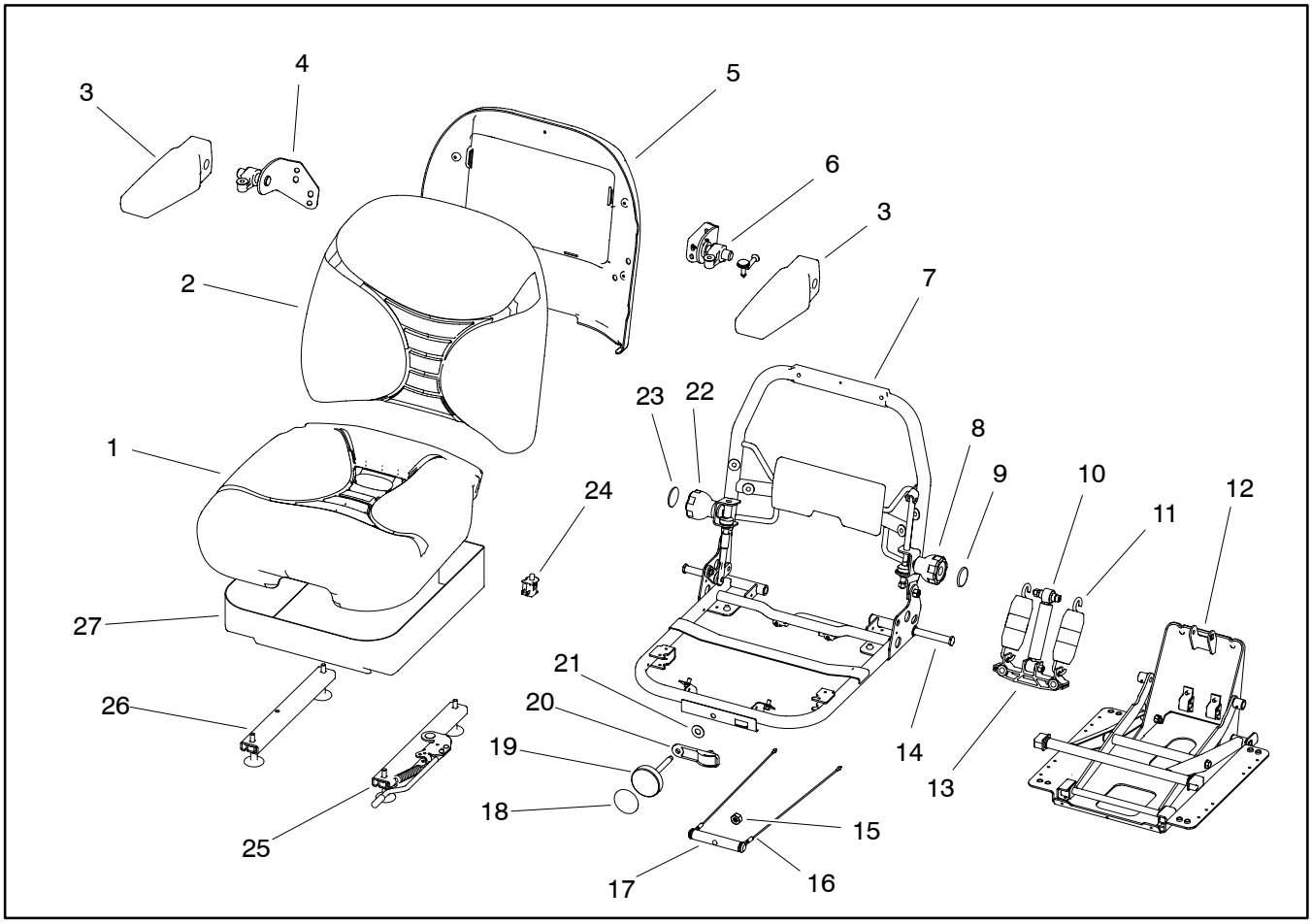

Figure 29

1. **Bottom cushion**
2. **Back cushion**
3. **Armrest**
4. **RH armrest mount assembly**
5. **Back panel**
6. **LH armrest mount assembly**
7. **Seat frame assembly**
8. **Lumbar support knob**
9. **Label**
10. **Shock absorber assembly**
11. **Suspension spring (2 used)**
12. **Suspension base**
13. **Spring saddle**
14. **Bearing shaft**
15. **Hex nut**
16. **Cable (2 used)**
17. **Weight adjust bar**
18. **Label**
19. **Weight adjustment knob**
20. **Weight indicator**
21. **Washer**
22. **Back rest knob**
23. **Label**
24. **Seat switch**
25. **Seat adjuster**
26. **Seat adjuster (slave)**
27. **Seat boot**

Removal (Fig. 29)

1. Remove operator seat from machine (see Operator Seat Removal in this section).

2. Remove armrest assemblies and then back panel from back of seat.

3. Carefully peel label from back rest knob (Fig. 30). Remove nut and knob from seat frame.

4. Remove six (6) x–mas tree clips that secure back cushion to seat frame. Remove back cushion.

5. Remove two (2) cap screws that secure bottom cushion to seat frame. Remove bottom cushion.

6. Remove hex nut that secures weight adjustment knob to weight adjust bar. Remove adjustment knob from weight adjust bar to remove cable tension. Remove cables from spring saddle.

7. Remove eighteen (18) x–mas tree clips from seat frame to separate seat boot from frame.

8. Remove two (2) roll pins that secure bearing shafts to seat frame. Remove bearing shafts and split nylon bushings from frame.

9. Lift seat frame from suspension base.

10. Remove nut and bolt that secure top of shock absorber to suspension base.

11. Slide spring saddle from spring arm while disengaging springs at top of suspension base.

12. Remove springs from spring saddle. Pay close attention to orientation of springs and spring saddle for assembly purposes.

13. Remove nut and bolt that secure bottom of shock absorber to spring saddle. Remove shock absorber.

Installation (Fig. 29)

1. Secure bottom of shock absorber to spring saddle with nut and bolt.

2. Attach springs to spring saddle in the same orientation noted during removal.

3. Position spring saddle on spring arm and slide down. Hook spring ends on top of suspension base.

4. Using the suspension base as a pry point, place a prybar on the top of the spring saddle and push saddle down to elongate springs enough to allow installation of the bolt to the top of shock absorber and suspension base. Secure bolt in position with nut.

5. Position seat frame to suspension base.

6. Align bearing blocks on frame with receivers on suspension base and guide frame into place. Insert two (2) bearing shafts and split nylon bushings to suspension base and frame. Secure bearing shafts with two (2) roll pins.

7. Position cables under the seat frame bars and on top of suspension base. Insert cable ends in spring saddle slots.

8. Pass weight adjustment knob shaft through weight indicator, washer and seat frame hole. Thread knob shaft into weight adjust bar. Install hex nut on knob shaft.

9. Position seat boot to seat frame and secure with eighteen (18) x–mas tree clips.

10. Position bottom cushion to seat frame and secure with two (2) cap screws.

11. Position back cushion to seat frame and secure with six (6) x–mas tree clips.

12. Assemble back rest knob to seat and secure with nut. Apply label to knob.

13. Assemble back panel and then armrest assemblies to seat.

14. Install operator seat on machine (see Operator Seat Installation in this section).

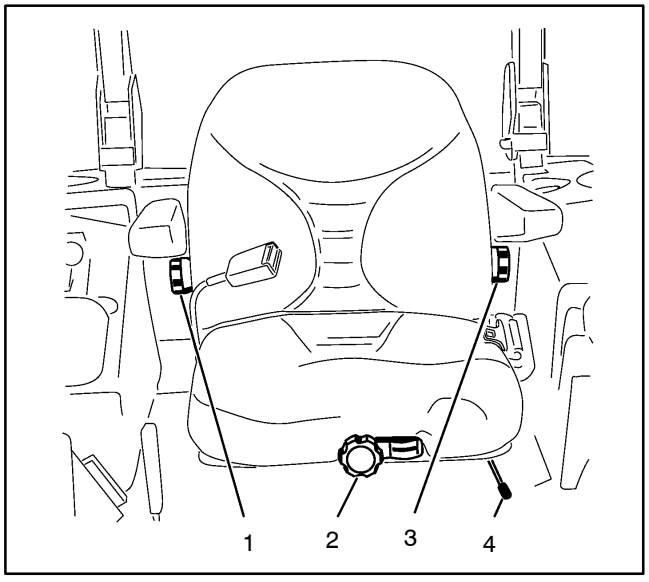

Figure 30

1. **Back rest knob**
2. **Seat suspension knob**
3. **Lumbar support knob**
4. **Seat position lever**

Hood

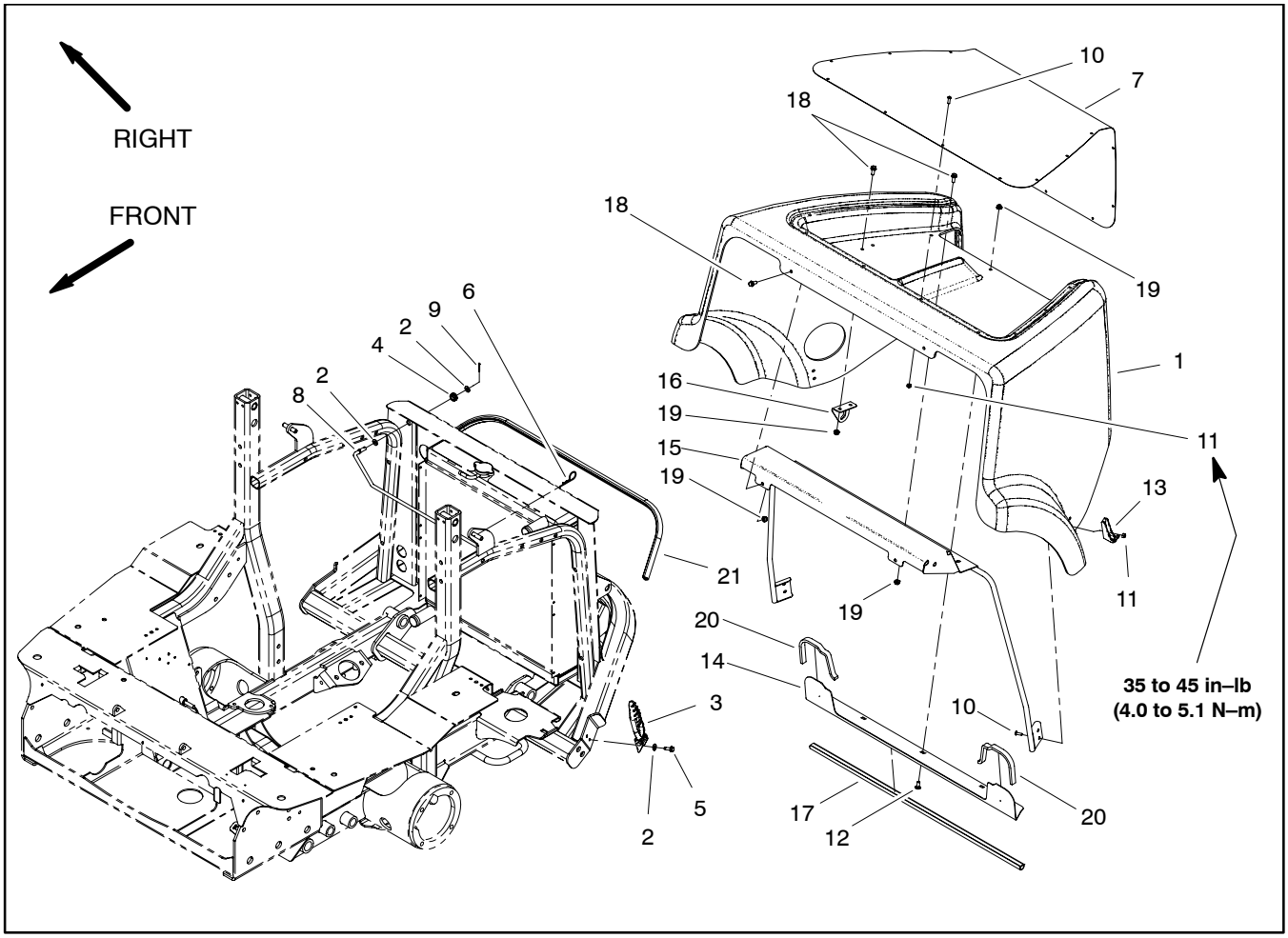

Figure 31

1. **Hood**
2. **Flat washer (4 used)**
3. **Rubber latch (2 used)**
4. **Grommet**
5. **Washer head screw (2 used)**
6. **Hair pin cotter**
7. **Intake screen**
8. **Hood prop rod**
9. **Cotter pin**
10. **Screw (21 used)**
11. **Lock nut (21 used)**
12. **Cap screw (3 used)**
13. **Latch catch (2 used)**
14. **Seal angle**
15. **Hood support**
16. **Prop rod support**
17. **Bulb seal**
18. **Flange head screw (8 used)**
19. **Flange nut (11 used)**
20. **Foam seal (2 used)**
21. **Bulb seal**

Removal (Fig. 31)

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Unlatch and raise hood.

3. Remove hair pin cotter (item 6) from left side frame rod.

4. Slide hood to left side of machine to free hood support from frame rods.

5. Remove hood from machine.

6. If necessary, remove hood components using Figure 31 as a guide.

Installation (Fig. 31)

1. Install all removed hood components using Figure 31 as a guide. If intake screen was removed from hood, make sure that hood support, seal angle and prop rod support are attached to hood before installing screen. Secure screen to hood with screws and lock nuts. Torque fasteners that secure screen from **35 to 45 in–lb (4.0 to 5.1 N–m)**.

2. Check condition of all seals on frame and hood. Replace damaged or missing seals. Check that no gaps exist between hood components and machine frame. If necessary, seal gaps with silicone caulk.

3. Position hood to machine and slide hood support onto frame rods.

4. Secure hood to frame rods with hair pin cotter (item 6).

5. Close and latch hood.

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Chapter 7

Cutting Deck

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General Information

Specifications

Several cutting decks are available for the Groundsmaster 7200 and Groundsmaster 7210. Refer to the Operator's Manual for specifications and optional accessories for the cutting deck used on your Groundsmaster.

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for the cutting deck on your Groundsmaster machine. Refer to that publication for additional information when servicing the cutting deck.

Factors That Can Affect Cutting Performance

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, “sponginess” or attempting to cut off too much grass height may not always be overcome by adjusting the machine. It is important to remember that the lower the height–of–cut, the more critical these factors are.

Remember that the “effective” or actual height–of–cut depends on cutting deck weight and turf conditions.

Factor	Possible Problem/Correction
1. Maximum governed engine speed.	Check maximum governed engine speed. Adjust engine speed to specifications if necessary (see Chapter 3 – Kubota Diesel Engine).
2. Blade speed.	All cutting deck blades should rotate at the same speed.
3. Tire pressure.	Check air pressure of all tires including castor tires. Adjust to pressures specified in Operator’s Manual.
4. Blade condition.	Sharpen blades if their cutting edges are dull or nicked. Inspect blade sail for wear or damage. Replace blade if needed.
5. Mower housing condition.	Make sure that cutting chamber is in good condition. Keep underside of deck clean. Debris buildup will reduce cutting performance.
6. Height–of–cut.	Adjust deck as specified in the Operator’s Manual. Effective (actual) height–of–cut will be different than the bench set height–of–cut.
7. Cutting deck alignment and ground following.	Check lift arms for wear, damage or binding. Also, inspect for bent or damaged pivot shafts.
8. Anti–scalp roller condition.	All anti–scalp rollers should rotate freely. Replace rollers or roller shafts if worn or damaged.
9. Grass conditions.	Mow when grass is dry for best cutting results. Also, remove only 1” (2.5 cm) or 1/3 of the grass blade when cutting.

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Service and Repairs

WARNING

Do not start the engine and engage the PTO switch when the PTO drive shaft is disconnected from the cutting deck (or implement). If the engine is started and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result. If the PTO drive shaft is disconnected from the cutting deck (or implement), remove fuse F1 (15 amp) from fuse block to prevent unintentional engagement of the PTO clutch.

CAUTION

Never work on the cutting deck with the engine running. Always stop engine and remove key from ignition switch first.

Blade Stopping Time

The blades of the cutting deck should come to a complete stop in less than seven (7) seconds after the PTO switch is disengaged.

NOTE: When checking blade stopping time, make sure the deck is lowered onto a clean section of turf or hard surface to avoid dust and debris.

To verify blade stopping time, have a second person stand back a safe distance from the machine and watch the blades on the cutting deck. When the machine operator disengages the cutting deck, record the time it takes for the blades to come to a complete stop. If this time is greater than seven (7) seconds, the PTO brake assembly in the transmission should be inspected.

Cutting Deck Removal and Installation

Removal

1. Park machine on a level surface with the cutting deck in the **fully raised** position. Stop engine, engage parking brake and remove key from the ignition switch.

NOTE: When the cutting deck is in the raised position, pull link torsion spring tension is reduced making it much easier to disconnect pull links from machine.

2. Disconnect pull link from each side of machine (Fig. 1):

CAUTION

Be careful when disconnecting the pull links. The pull link torsion springs may cause some rotation of pull links during the removal process.

A. Remove shoulder screw that secures retainer pin to carrier frame.

B. Carefully slide retainer pin from carrier frame and pull link.

3. Note location of HOC pin in HOC bracket for assembly purposes (Fig. 2). Remove HOC pin from HOC bracket.

4. Start engine and fully lower cutting deck. Stop engine and remove key from the ignition switch.

WARNING

Do not start the engine and engage the PTO switch when the PTO drive shaft is disconnected from the cutting deck. If the engine is started and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result. If the PTO drive shaft is disconnected from the cutting deck, remove fuse F1 (15 amp) from fuse block to prevent unintentional engagement of the PTO clutch.

5. To prevent unintentional engagement of the PTO clutch, remove fuse F1 (15 amp) from fuse block.

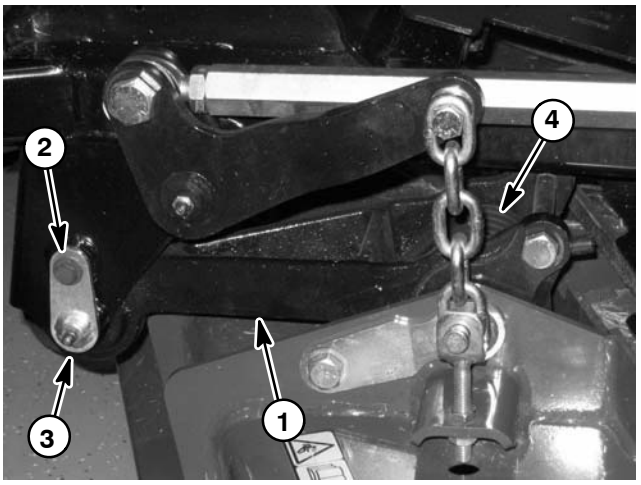

Figure 1

1. Pull link (deck raised)
2. Shoulder screw
3. Retainer pin
4. Torsion spring

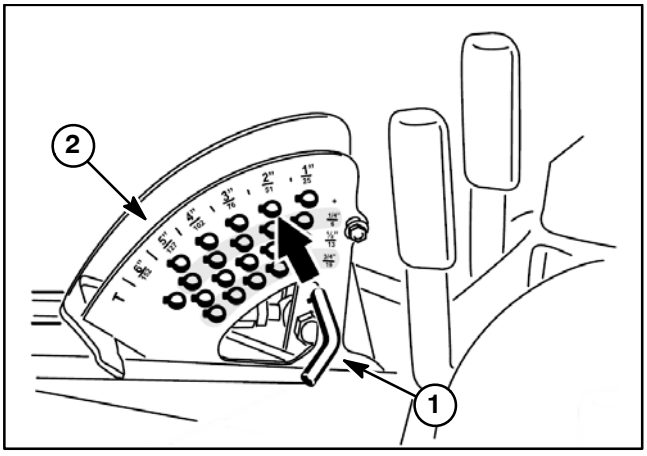

Figure 2

1. HOC pin
2. HOC bracket

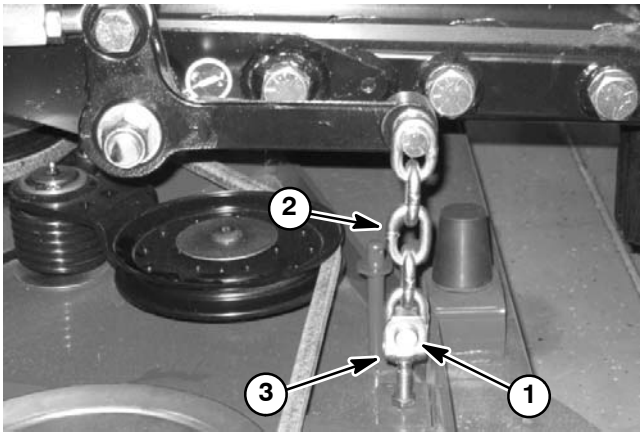

Figure 3

1. Clevis pin
2. Deck lift chain
3. Adjustment clevis

6. Disconnect end yoke of PTO drive shaft from cutting deck gearbox shaft (see PTO Drive Shaft Removal in the Service and Repairs section of Chapter 6 – Chassis). Position and support drive shaft end away from deck gearbox.

7. Remove four (4) ring pins and clevis pins that secure deck lift chains to adjustment clevises on cutting deck (Fig. 3).

8. Slide cutting deck away from machine.

Installation

1. Slide cutting deck under carrier frame of machine.

2. Install four (4) clevis pins and ring pins to secure deck lift chains to adjustment clevises on cutting deck (Fig. 3).

3. Connect end yoke of PTO drive shaft to cutting deck gearbox shaft (see PTO Drive Shaft Installation in the Service and Repairs section of Chapter 6 – Chassis).

4. Start engine and fully raise cutting deck. Stop engine and remove key from the ignition switch.

CAUTION

Be careful when connecting the pull links to the machine. The pull link torsion springs may cause some rotation of pull links during installation.

5. Align pull link to carrier frame and attach link with retainer pin. Secure retainer pin to frame with shoulder screw (Fig. 1).

6. Install HOC pin into HOC bracket to allow desired height–of–cut (Fig. 2).

7. Install fuse F1 (15 amp) into fuse block.

Idler Assembly

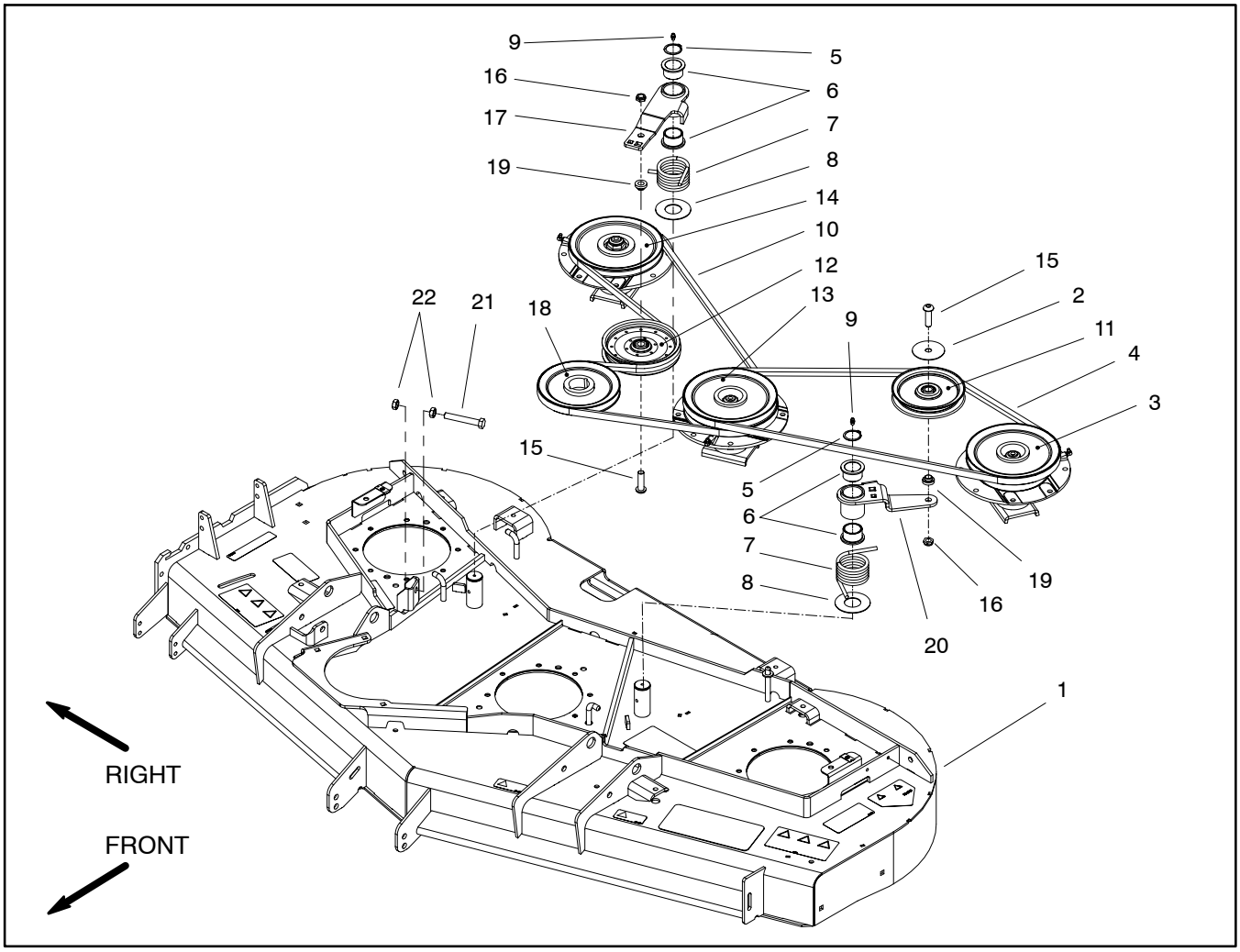

Figure 4

1. **Cutting deck**
2. **Flat washer**
3. **LH spindle assembly**
4. **Drive belt**
5. **Snap ring**
6. **Flange bushing**
7. **Torsion spring**
8. **Washer**
9. **Grease fitting**
10. **Drive belt**
11. **Idler pulley**
12. **Idler pulley**
13. **Center spindle assembly**
14. **RH spindle assembly**
15. **Socket head screw**
16. **Lock nut**
17. **RH idler arm**
18. **Drive pulley**
19. **Idler spacer**
20. **LH idler arm**
21. **Stop bolt**
22. **Jam nut**

Removal (Fig. 4)

1. Park machine on a level surface with cutting deck (or implement) lowered. Stop engine, engage parking brake and remove key from the ignition switch.

2. Lift the footrest, exposing the top of the cutting deck. Support the footrest with prop rod.

3. Remove deck covers from top of cutting deck.

4. Loosen jam nuts (item 22) that secure idler stop bolt (item 21) to cutting deck to allow clearance between idler and stop bolt. Remove drive belt from deck pulleys.

5. Insert nut driver or small piece of pipe onto the end of the torsion spring for the idler arm.

CAUTION

Be careful when removing tension from the idler arm torsion spring. The spring is under heavy load and may cause personal injury.

6. Carefully push the torsion spring end down and away from the idler arm to unhook the spring from the arm.

7. Remove snap ring that retains idler arm assembly to cutting deck.

8. Remove idler components as needed using Figure 4 as a guide.

Installation (Fig. 4)

1. Install removed idler components using Figure 4 as a guide. Secure idler arm assembly to cutting deck with snap ring.

2. Insert nut driver or small piece of pipe onto the end of the torsion spring for the idler arm.

CAUTION

Be careful when applying tension to the idler arm torsion spring. The spring is under heavy load and may cause personal injury.

3. Carefully push down on the torsion spring end to get the spring under the idler arm mounting plate. Then release the spring slowly to lock it into place.

4. Install drive belt to pulleys.

5. If idler arm on right side of cutting deck was removed, check that clearance between idler arm and stop bolt is from **0.100" to 0.160" (2.5 to 4.0 mm)** (Fig. 5). If necessary, adjust jam nut location on stop bolt to allow proper clearance.

6. Install deck covers to cutting deck. Lower the footrest.

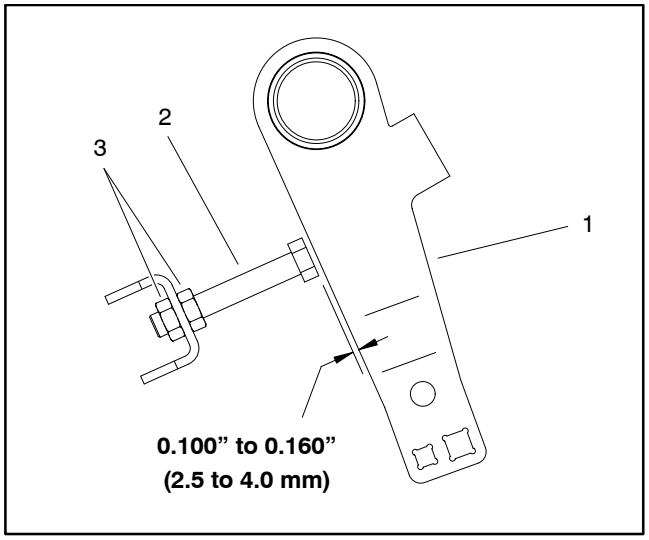

Figure 5

1. **Idler arm**
2. **Stop bolt**
3. **Jam nut**

Blade Spindle

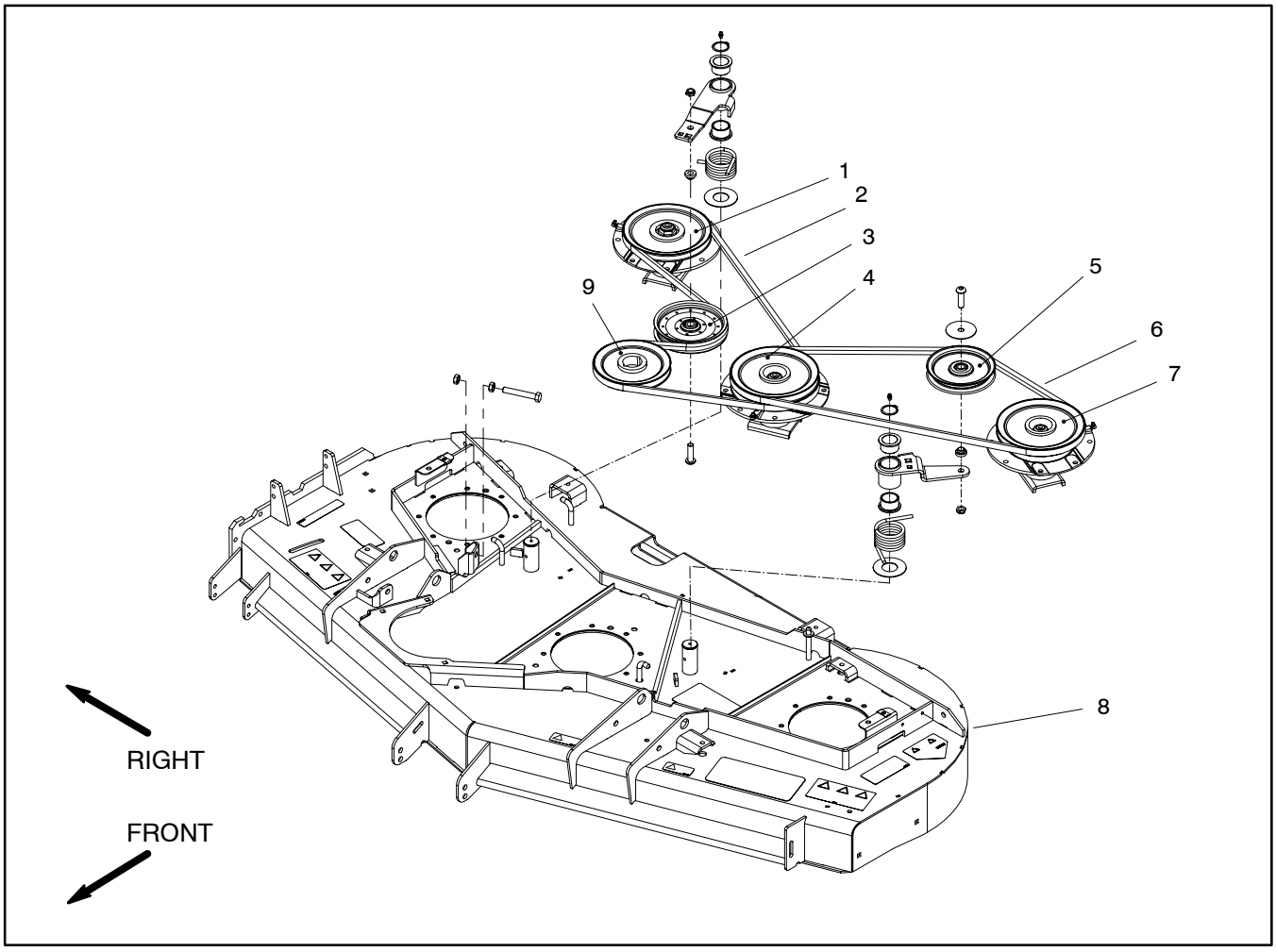

Figure 6

1. **RH spindle assembly**
2. **Drive belt**
3. **Idler pulley**
4. **Center spindle assembly**
5. **Idler pulley**
6. **Drive belt**
7. **LH spindle assembly**
8. **Cutting deck**
9. **Drive pulley**

Removal (Fig. 6)

1. Park machine on a level surface with cutting deck raised. Stop engine, engage parking brake and remove key from the ignition switch. Support the cutting deck so it cannot fall accidentally.

2. Lift the footrest, exposing the top of the cutting deck. Support the footrest with prop rod.

3. Remove belt covers from top of cutting deck.

NOTE: When removing deck drive belt, use breaker bar in idler arm square drive holes to rotate idler pulley away from belt (Fig. 7).

4. Remove drive belt from deck pulleys (see Operator's Manual).

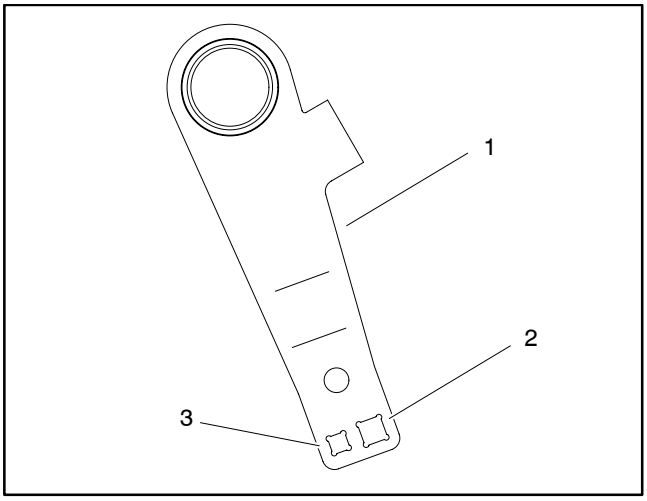

Figure 7

1. **Idler arm (RH shown)**
2. **1/2" square drive**
3. **3/8" square drive**

5. Remove cutting blade, anti–scalp cup and blade bolt from spindle to be serviced (Fig. 8).

6. Remove eight (8) flange head screws and flange nuts that secure spindle assembly to deck. Remove spindle assembly from deck.

Installation (Fig. 6)

1. Position spindle on cutting deck noting orientation of grease fitting (Fig. 9). Secure spindle assembly to deck with eight (8) flange head screws and flange nuts.

2. Install cutting blade, anti–scalp cup and blade bolt (Fig. 8). Tighten blade bolt from **88 to 108 ft–lb (119 to 146 N–m)**.

3. Slowly rotate cutting blades to verify that blades do not contact any deck component(s).

4. Install drive belt to pulleys.

5. Lubricate spindle grease fittings.

6. Install belt covers to cutting deck. Lower the footrest.

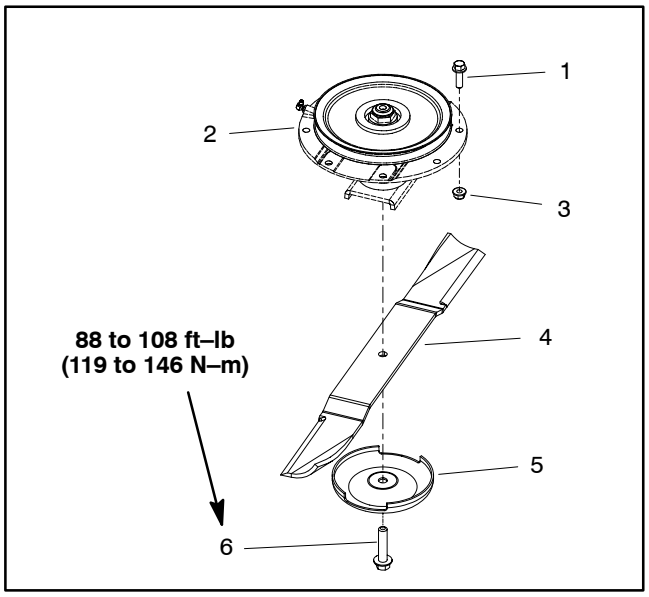

Figure 8

1. **Flange screw (8 used)**
2. **Spindle assembly**
3. **Flange nut (8 used)**
4. **Blade**
5. **Anti–scalp cup**
6. **Blade bolt**

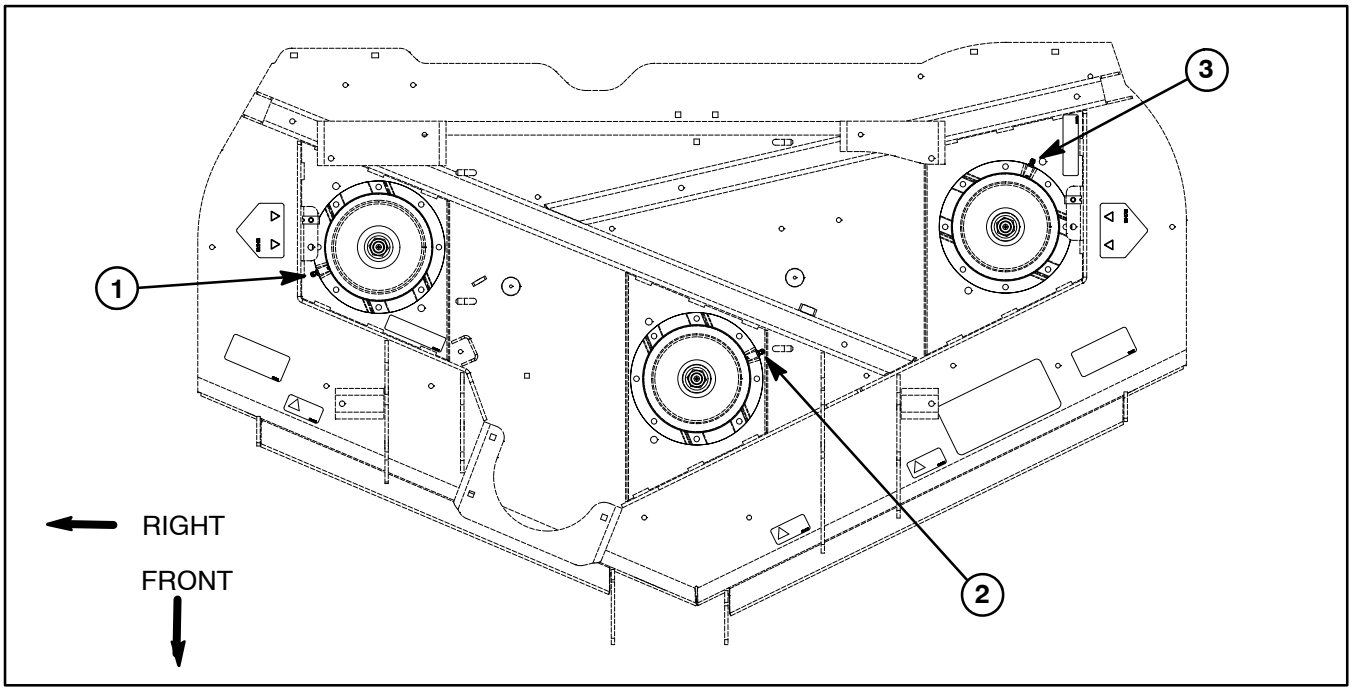

Figure 9

1. **RH spindle grease fitting**
2. **Center spindle grease fitting**
3. **LH spindle grease fitting**

Blade Spindle Service

Disassembly (Fig. 10)

1. Remove lock nut from top of spindle shaft.

NOTE: Early production spindle assemblies included a v–ring seal (item 4) which has been found to be unnecessary. Discard v–ring seal if found in spindle assembly.

2. Remove special hardened washer and pulley from shaft. If spindle is equipped with a v–ring seal, remove and discard v–ring seal.

3. Remove the spindle shaft from the spindle housing which may require the use of an arbor press. The spindle shaft spacer should remain on the spindle shaft as the shaft is being removed.

4. Remove oil seals from spindle housing.

5. Remove the bearing cones, O–ring, inner bearing spacer and spacer ring from the spindle housing.

6. Using an arbor press, remove both of the bearing cups and the outer bearing spacer from the housing.

7. The large snap ring can remain inside the spindle housing. Removal of this snap ring is very difficult.

Assembly (Fig. 10)

NOTE: A replacement spindle bearing set contains two (2) bearings, a spacer ring and a large snap ring (items 1, 2 and 3 in Fig. 11). These parts cannot be purchased separately. Also, do not mix bearing set components from one deck spindle to another.

NOTE: A replacement bearing spacer set includes the inner spacer and outer spacer (items 4 and 5 in Fig. 11). Do not mix bearing spacers from one deck spindle to another.

IMPORTANT: If new bearings are installed into a used spindle housing, it may not be necessary to replace the original large snap ring. If the original snap ring is in good condition with no evidence of damage (e.g. spun bearing), leave the snap ring in the housing and discard the snap ring that comes with the new bearings. If the large snap ring is found to be damaged, replace the snap ring.

1. If large snap ring was removed from spindle housing, install snap ring into housing groove. Make sure snap ring is fully seated in housing groove.

2. Install outer spacer into top of spindle housing. The spacer should fit against the snap ring.

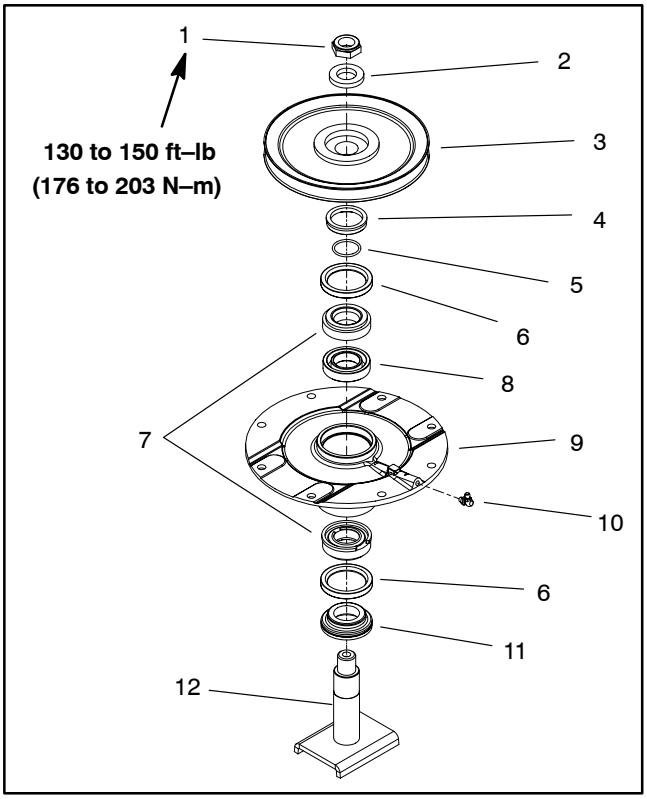

Figure 10

1. **Lock nut**
2. **Special hardened washer**
3. **Pulley**
4. **V–ring seal (if equipped)**
5. **O–ring**
6. **Oil seal**
7. **Bearing set**
8. **Spacer set**
9. **Spindle housing**
10. **Grease fitting**
11. **Shaft spacer**
12. **Spindle shaft**

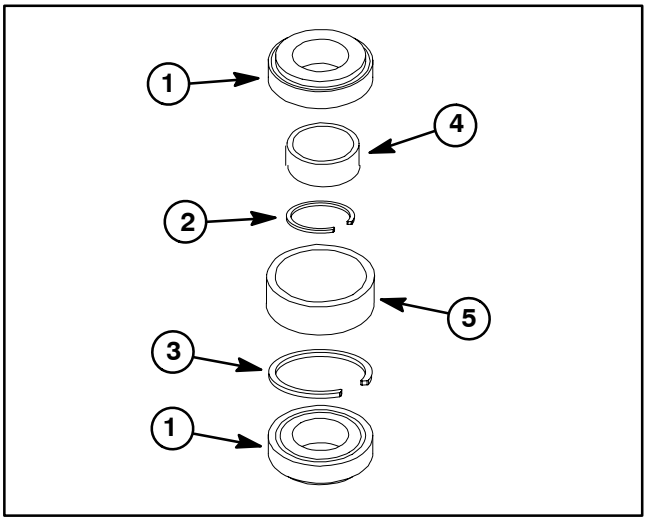

Figure 11

1. **Bearing**
2. **Spacer ring**
3. **Large snap ring**
4. **Inner spacer**
5. **Outer spacer**

3. Using an arbor press, push the bearing cups into the top and bottom of the spindle housing. The top bearing cup must contact the outer spacer previously installed, and the bottom bearing cup must contact the snap ring. Make sure that the assembly is correct by supporting the first bearing cup and pressing the second cup against it (Fig 12).

4. Pack the bearing cones with grease. Apply a film of grease on lips of oil seals and O–ring.

5. Install lower bearing cone and oil seal into bottom of spindle housing. **Note:** The bottom seal must have the lip facing out (down) (Fig. 13). This seal installation allows grease to purge from the spindle during the lubrication process.

IMPORTANT: If bearings are being replaced, make sure to use the spacer ring that is included with new bearing set (Fig. 11).

6. Slide spacer ring and inner bearing spacer into spindle housing, then install upper bearing cone and oil seal into top of housing. **Note:** The upper seal must have the lip facing in (down) (Fig. 13). Make sure upper seal is flush to 0.080" (2.0 mm) recessed to housing surface.

7. Inspect the spindle shaft and shaft spacer to make sure there are no burrs or nicks that could possibly damage the oil seals. Lubricate the shaft and spacer with grease.

8. Install spindle shaft spacer onto shaft. Place thin sleeve or tape on spindle shaft splines to prevent seal damage during shaft installation.

9. Carefully slide spindle shaft with spacer up through spindle housing. The bottom oil seal and spindle spacer fit together when the spindle is fully installed.

10. Install O–ring to top of spindle shaft (Fig. 14).

NOTE: Early production spindle assemblies included a v–ring seal which has been found to be unnecessary. **Do not** install a v–ring seal when assembling the spindle.

11. Install pulley (hub down), special hardened washer and lock nut to spindle shaft (Fig. 14). Tighten lock nut from **130 to 150 ft–lb (176 to 203 N–m)**.

IMPORTANT: Pneumatic grease guns can produce high pressure inside spindle housing that can damage spindle seals. Pneumatic grease guns, therefore, are not recommended to be used for greasing of spindle housings.

12. Attach a hand pump grease gun to grease fitting on housing and fill housing cavity with grease until grease starts to come out of lower seal.

13. Rotate spindle shaft to make sure that it turns freely.

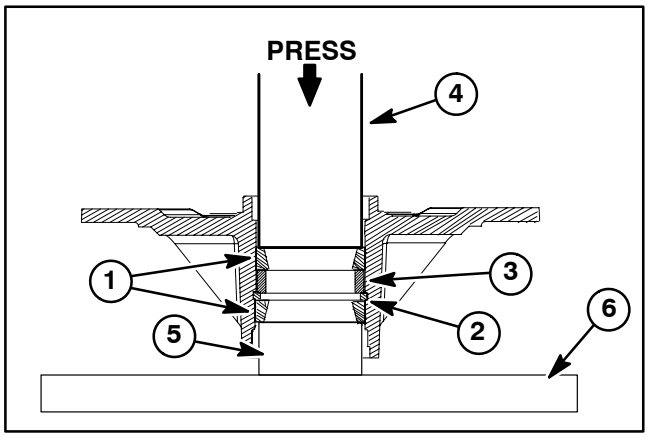

Figure 12

1. Bearing cup
2. Large snap ring
3. Outer spacer
4. Arbor press
5. Support
6. Arbor press base

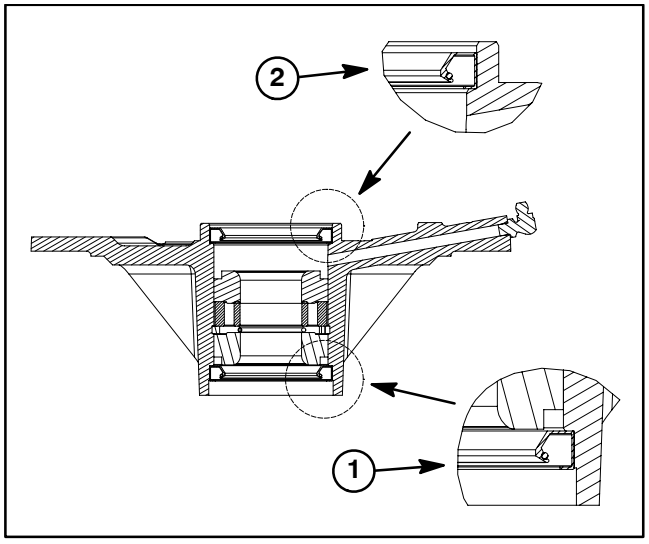

Figure 13

1. Bottom seal installation
2. Upper seal installation

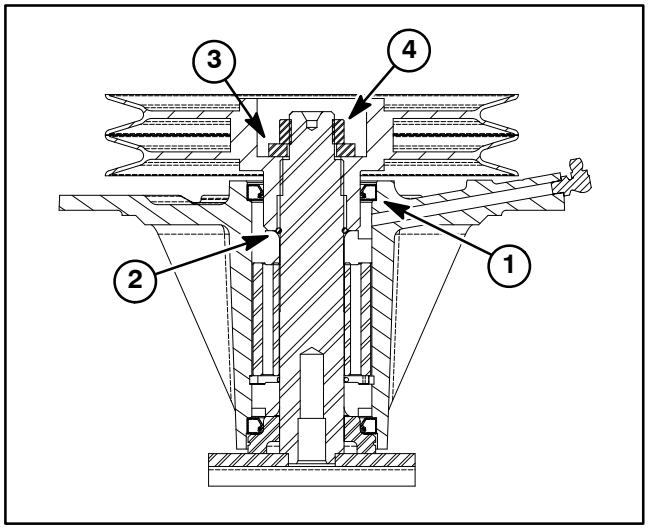

Figure 14

1. Upper seal
2. O–ring
3. Flat washer
4. Lock nut

Gearbox

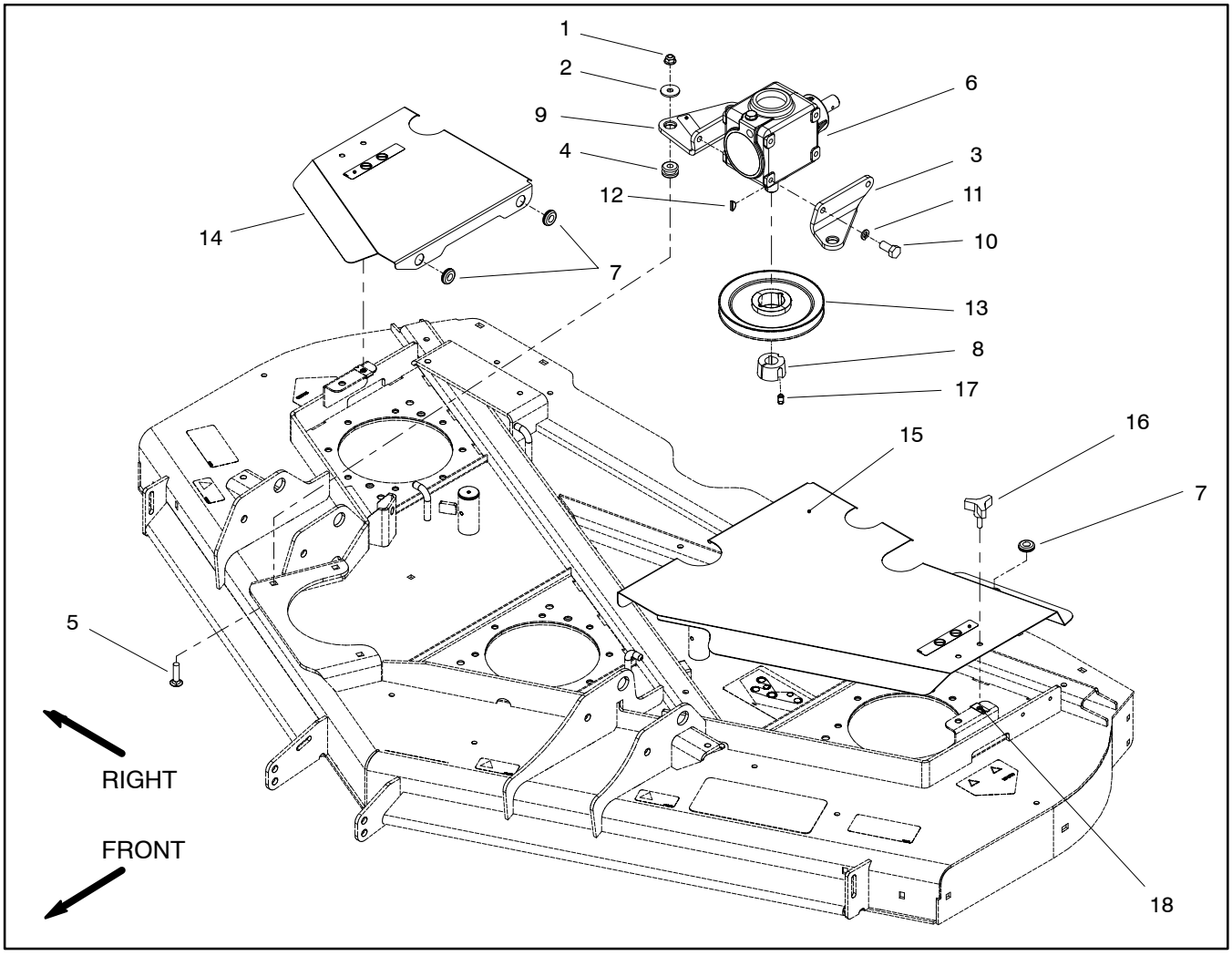

Figure 15

1. **Flange nut (3 used)**
2. **Washer (3 used)**
3. **LH gearbox bracket**
4. **Mount (3 used)**
5. **Carriage screw (3 used)**
6. **Gearbox**
7. **Grommet (5 used)**
8. **Taperlock bushing**
9. **RH gearbox bracket**
10. **Cap screw (4 used)**
11. **Lock washer (4 used)**
12. **Woodruff key**
13. **Deck drive pulley**
14. **RH deck cover**
15. **LH deck cover**
16. **Knob (2 used)**
17. **Set screw (2 used)**
18. **Retainer nut (2 used)**

Removal (Fig. 15)

1. Park machine on a level surface, lower cutting deck (or implement), stop engine, engage parking brake and remove key from the ignition switch.

2. Lift the footrest, exposing the top of the cutting deck. Support the footrest with prop rod.

3. Remove belt covers from top of cutting deck.

4. Remove drive belt from deck pulleys.

WARNING

Do not start the engine and engage the PTO switch when the PTO drive shaft is disconnected from the cutting deck (or implement). If the engine is started and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result. If the PTO drive shaft is disconnected from the cutting deck (or implement), remove fuse F1 (15 amp) from fuse block to prevent unintentional engagement of the PTO clutch.

5. Disconnect PTO drive shaft from gearbox (see PTO Drive Shaft Removal).

6. Remove four (4) cap screws (item 10) and lock washers (item 11) that secure gearbox assembly to gearbox brackets.

7. Remove fasteners that secure left side gearbox bracket (item 3) to deck mounting plate. Remove bracket from deck.

8. Remove gearbox assembly, with drive pulley attached, from deck. Drain lubricant from gearbox.

9. Remove two (2) set screws that secure taper lock bushing to drive pulley on gearbox shaft.

10. Thread one of the removed set screws into threaded hole of bushing (Fig. 16). Tighten set screw to loosen bushing from pulley hub.

11. Slide bushing and pulley from gearbox shaft. Locate and retrieve woodruff key.

12. If necessary, remove and replace oil seals and oil caps in gearbox (Fig. 17).

NOTE: If internal gearbox wear or damage occurs, gearbox replacement is necessary. Internal gearbox components are not available.

Installation (Fig. 15)

1. Clean gearbox output shaft, pulley ID and taper lock bushing thoroughly.

2. Position woodruff key, pulley and then taper lock bushing to gearbox output shaft. Slide bushing to shoulder on shaft. Align threaded holes of pulley with non–threaded holes of bushing.

3. Lightly oil threads of set screws and install screws into threads of pulley (Fig. 16). Alternately and evenly tighten set screws to a torque from **180 to 250 in–lb (20 to 28 N–m)**.

4. Fill allen recess in set screws and bushing threads with grease to prevent dirt from packing into crevices.

5. Position gearbox assembly, with drive pulley attached, to deck.

6. Position and secure left side gearbox bracket (item 12) to deck mounting plate.

7. Secure gearbox assembly to gearbox brackets with four (4) cap screws (item 10) and lock washers (item 11).

8. Connect PTO drive shaft to gearbox (see PTO Drive Shaft Installation).

9. Install drive belt and deck covers to cutting deck.

10. Torque plug in gearbox to **175 in–lb (19.8 N–m)**. Fill gearbox with lubricant.

11. Lower the footrest.

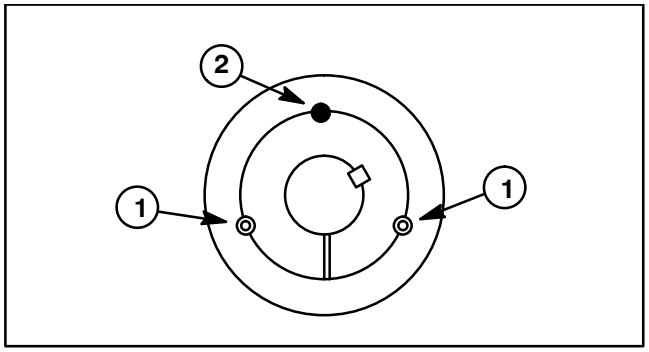

Figure 16

1. **Set screw installation position**
2. **Set screw removal position**

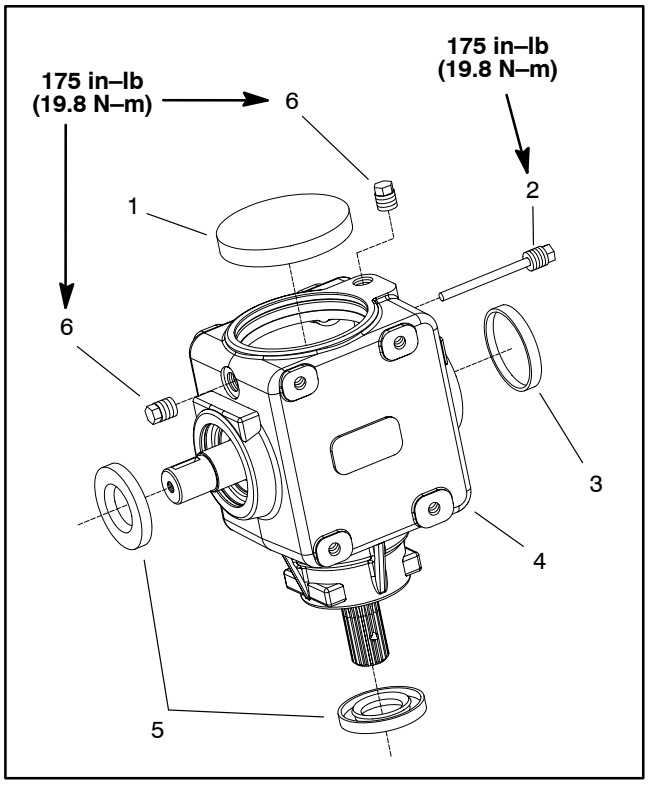

Figure 17

1. **Oil cap**
2. **Dipstick**
3. **Oil cap**
4. **Gearbox**
5. **Oil seal**
6. **Plug**

Cutting Deck Pull Links

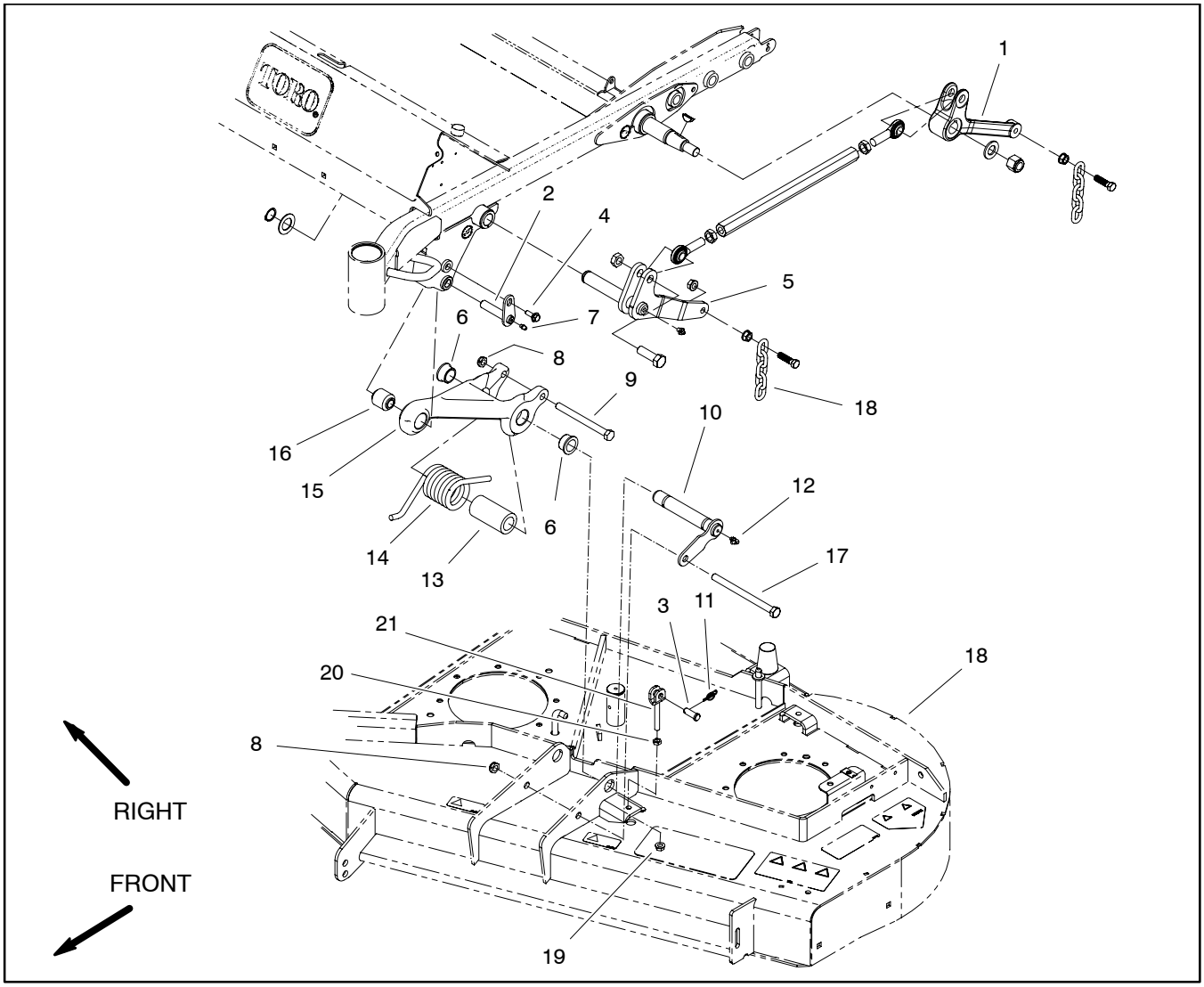

Figure 18

1. **LH lift arm**
2. **Retainer pin**
3. **Clevis pin**
4. **Shoulder screw**
5. **LH lift arm**
6. **Flange bushing**
7. **Grease fitting**
8. **Lock nut**
9. **Cap screw**
10. **Pivot pin**
11. **Ring pin**
12. **Grease fitting**
13. **Spacer**
14. **Torsion spring**
15. **Pull link assembly**
16. **Bushing**
17. **Cap screw**
18. **Cutting deck**
19. **Flange nut**
20. **Jam nut**
21. **Adjustment clevis**

Disassembly (Figs. 18 and 19)

1. Remove cutting deck from machine (see Cutting Deck Removal and Installation in this section).

CAUTION

Be careful when removing the pull links from the cutting deck. The pull link torsion springs may cause some rotation of pull links during the removal process.

2. To allow removal of pivot pin (item 10) from cutting deck and pull link, remove adjustment clevis from deck:

   A. Remove flange nut (item 19) that secures adjustment clevis to deck.

   B. Remove adjustment clevis from deck.

3. Remove lock nut (item 8) and cap screw (item 17) from deck and pivot pin (item 10).

4. Slide pivot pin (item 10) from deck and pull link.

5. Remove pull link with torsion spring and spacer from deck.

6. Inspect bushings (items 6 and 16) in pull link. Replace bushings if worn or damaged.

Assembly (Figs. 18 and 19)

NOTE: For 62" cutting decks, the torsion spring (item 14) is painted red. The torsion spring on 72" decks is painted black.

1. Place spacer inside torsion spring and then fit spring and spacer into pull link. Make sure that torsion spring end is below cap screw (item 9) in pull link.

2. Position pull link to cutting deck.

3. Slide pivot pin (item 10) through cutting deck, pull link and spacer.

4. Insert cap screw (item 17) through pivot pin and holes in deck. Make sure that torsion spring end is below screw. Secure cap screw with lock nut.

5. Install adjustment clevis to deck and secure with flange nut.

6. Install cutting deck to machine (see Cutting Deck Removal and Installation in this section).

7. Lubricate pull link grease fittings.

8. Check cutting deck mismatch and pitch. Adjust if necessary.

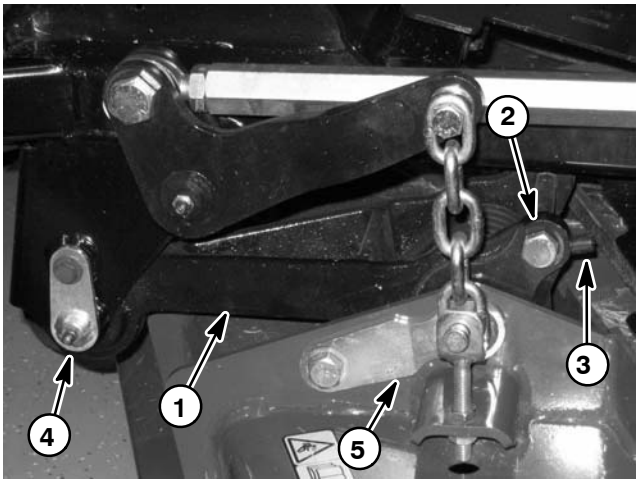

Figure 19

1. **Pull link (raised)**
2. **Cap screw**
3. **Torsion spring end**
4. **Retainer pin**
5. **Pivot pin**

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Chapter 8

Foldout Diagrams

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Foldout Diagrams

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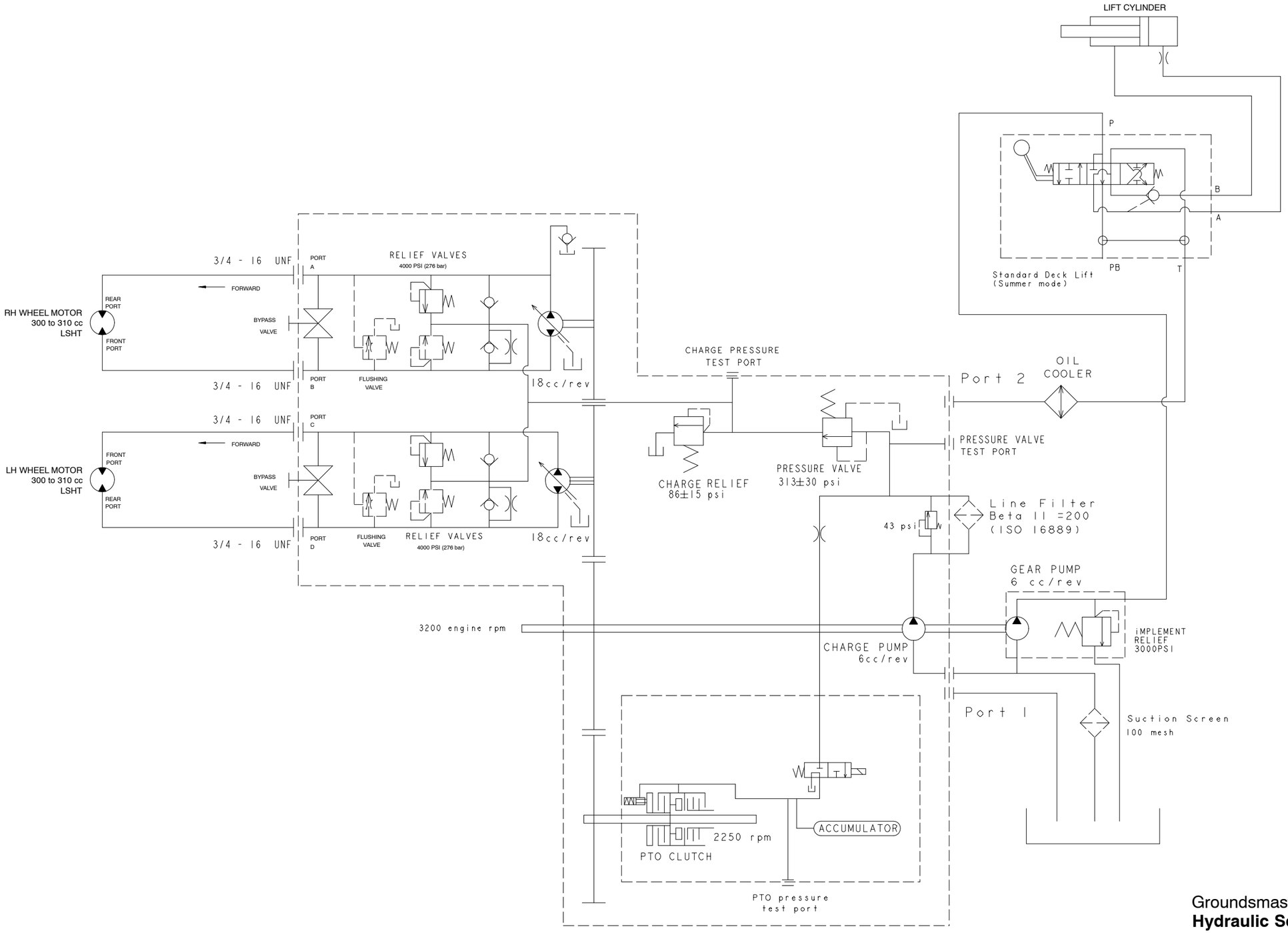
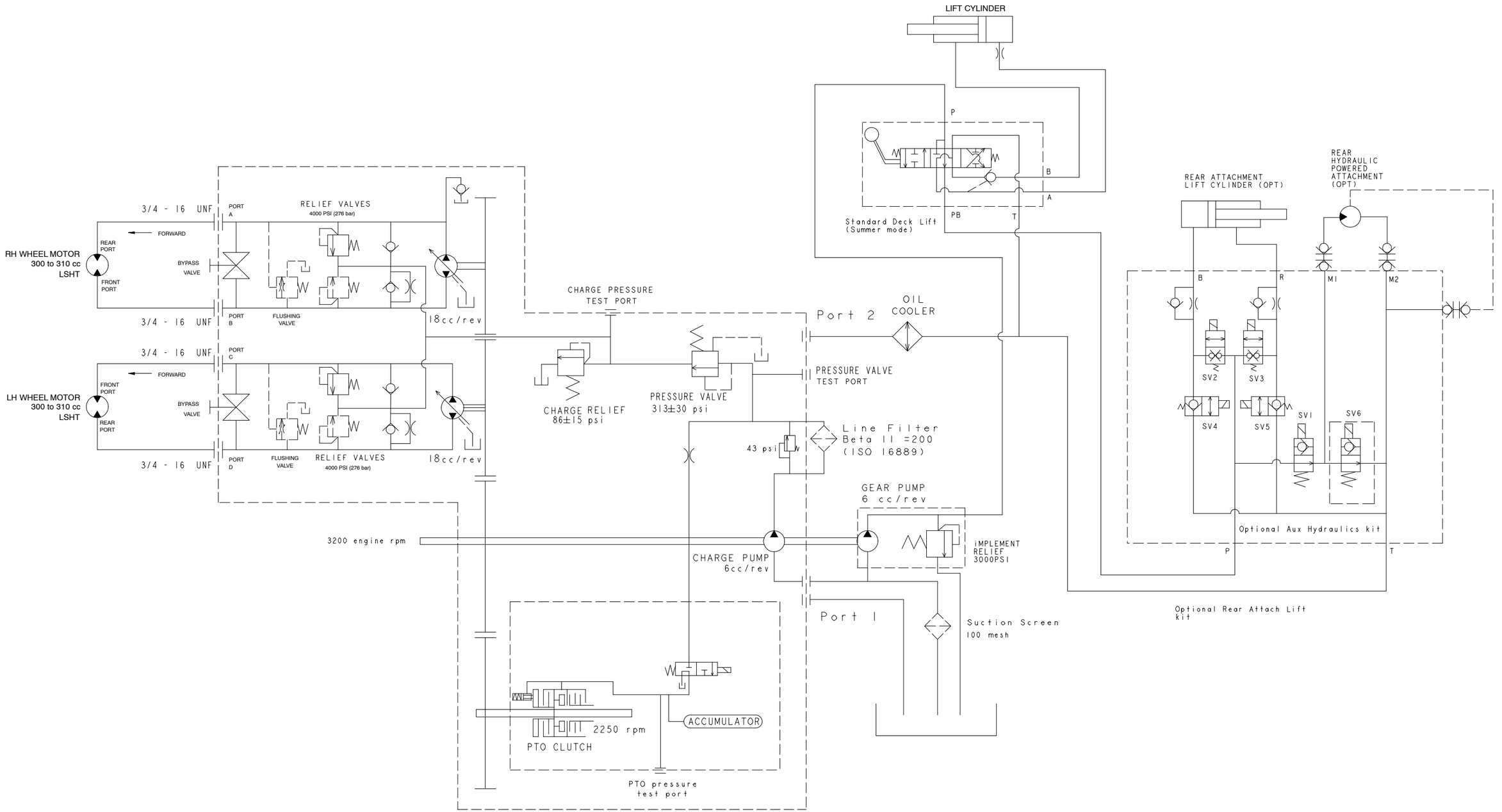


Groundsmaster 7200/7210

Hydraulic Schematic

All solenoids are shown as de–energized.

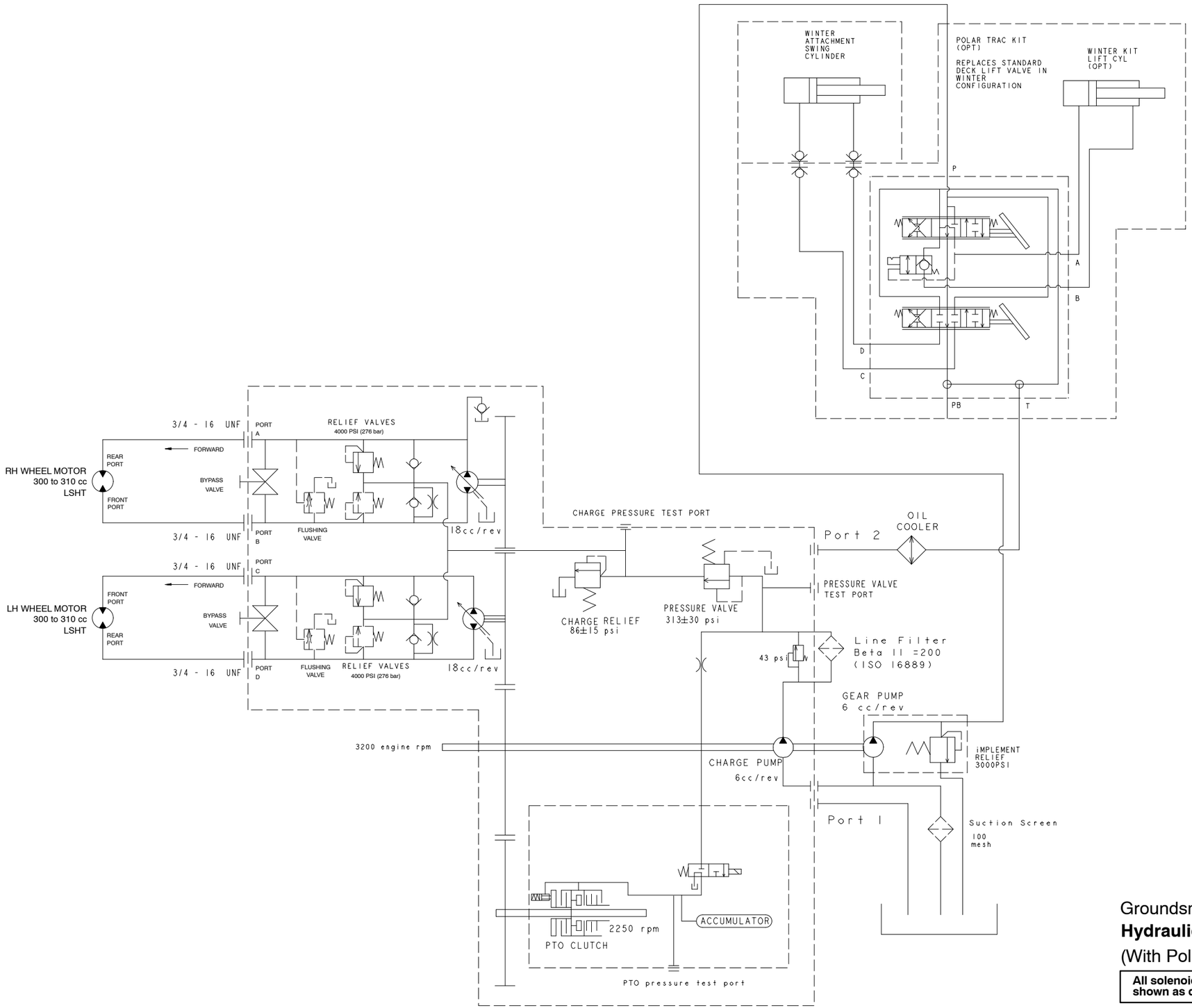


Groundsmaster 7200/7210

Hydraulic Schematic

(With Rear Attach Lift Kit Installed)

All solenoids are shown as de–energized.

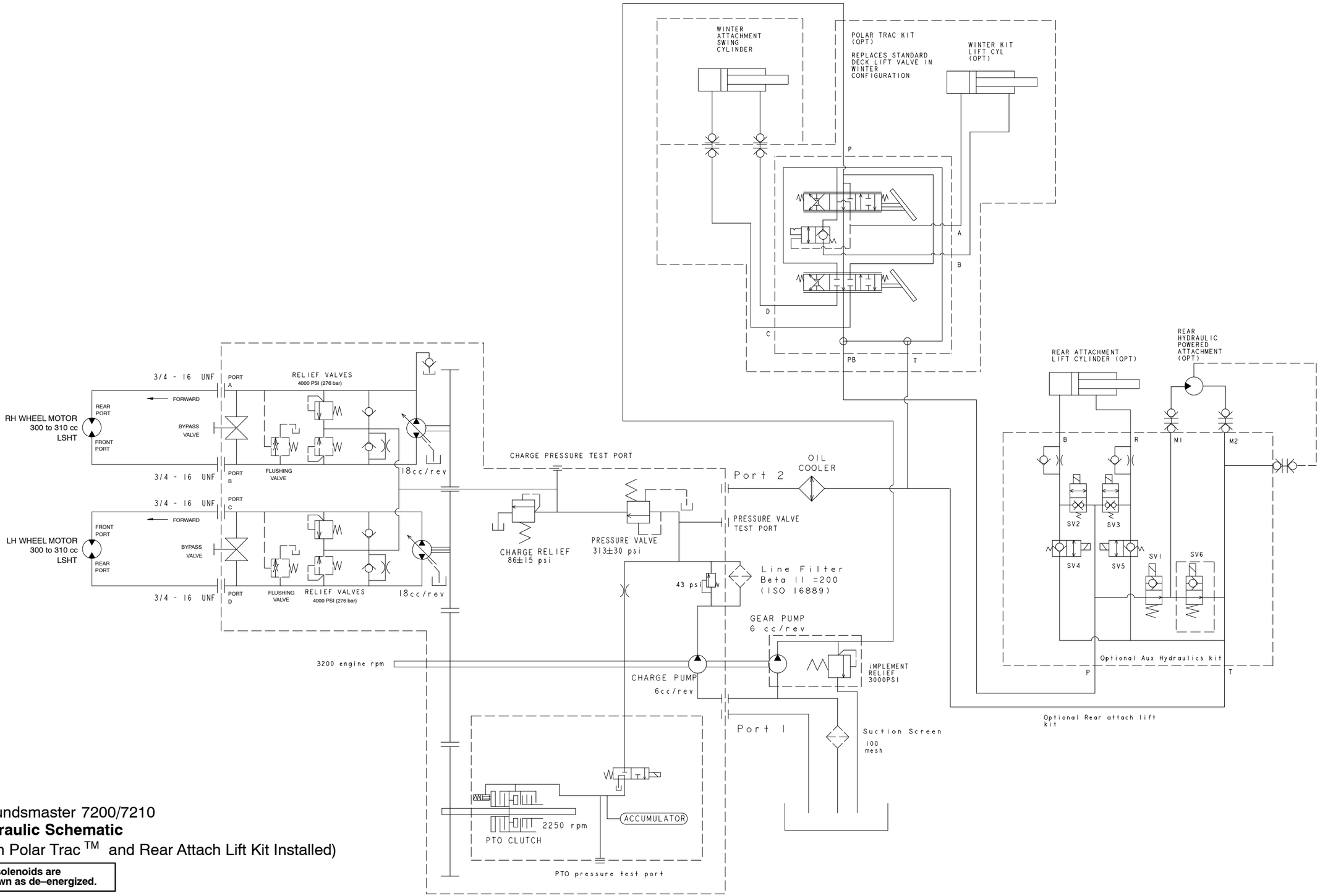


Groundsmaster 7200/7210

Hydraulic Schematic

(With Polar Trac ™)

All solenoids are shown as de–energized.

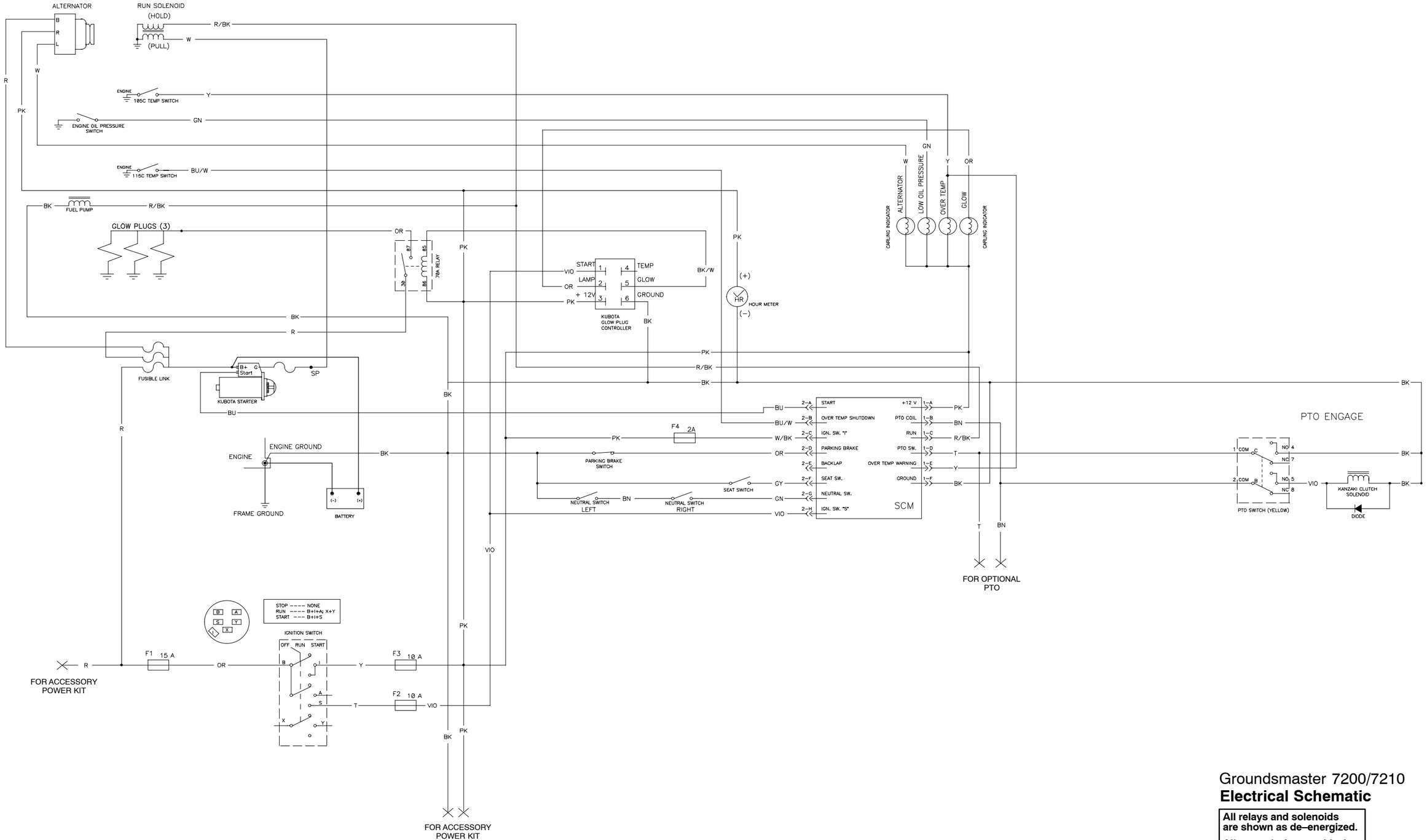


Groundsmaster 7200/7210

Hydraulic Schematic

(With Polar Trac ™ and Rear Attach Lift Kit Installed)

All solenoids are shown as de–energized.

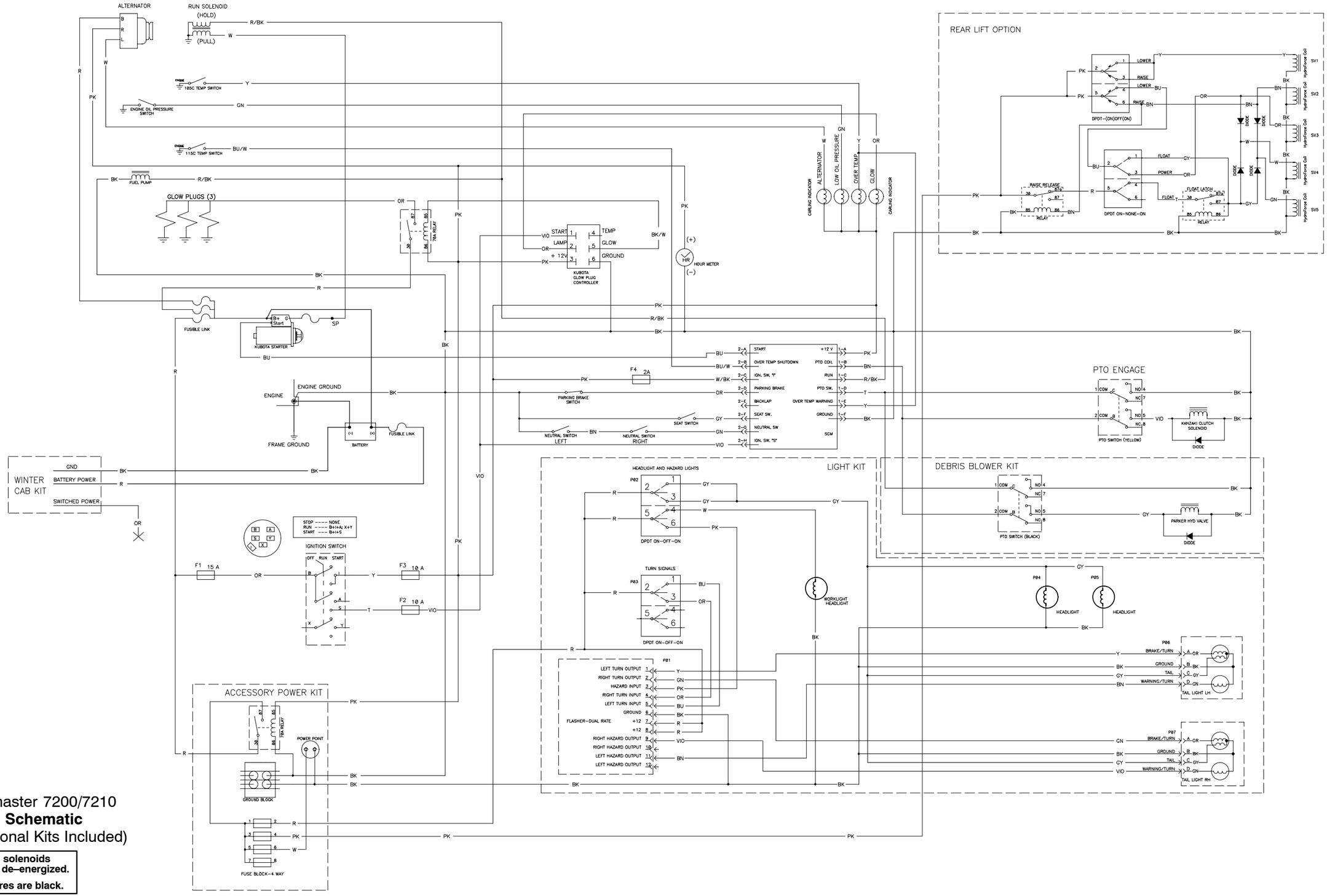


Groundsmaster 7200/7210

Electrical Schematic

All relays and solenoids are shown as de–energized.

All ground wires are black.



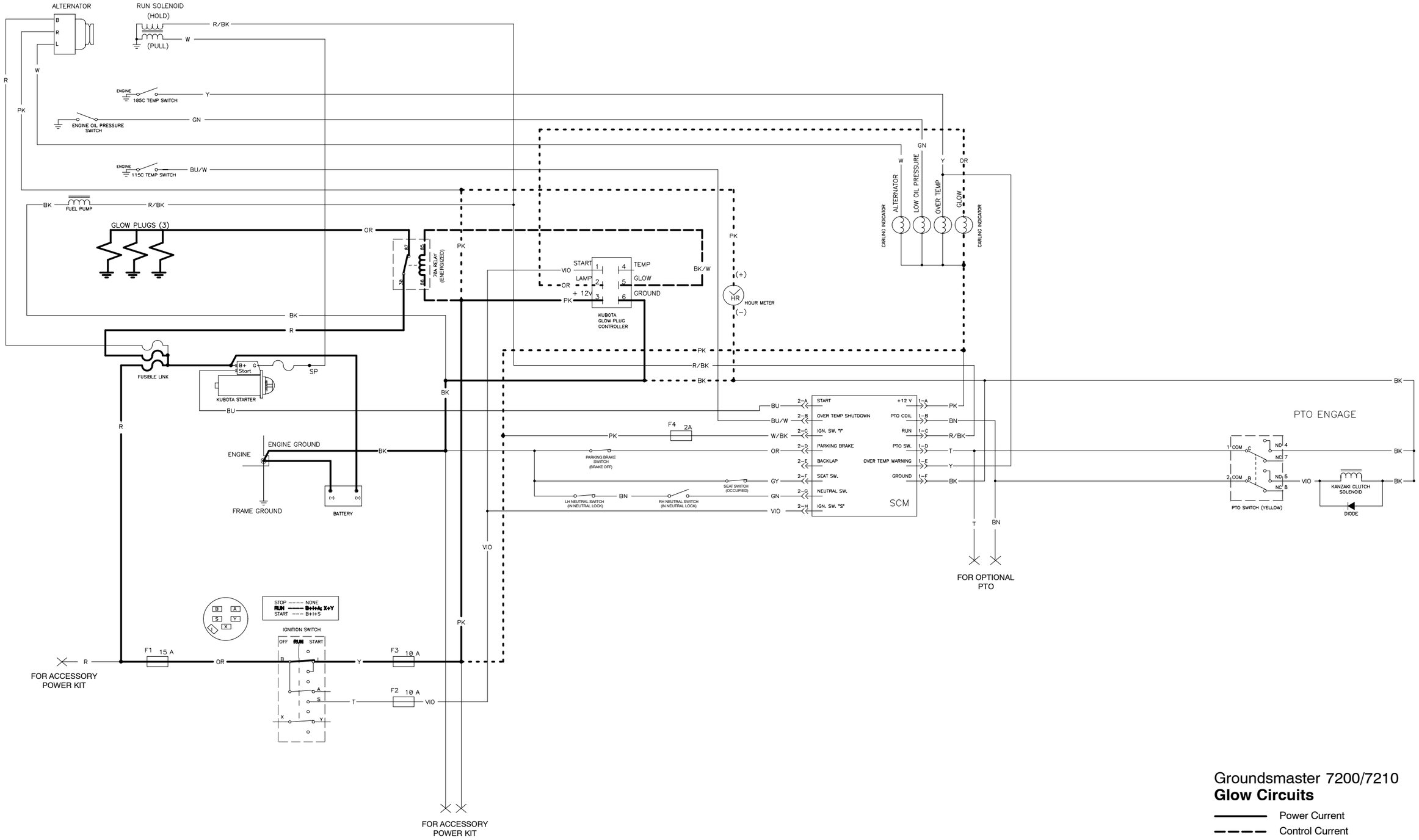
Groundsmaster 7200/7210

Electrical Schematic

(With Optional Kits Included)

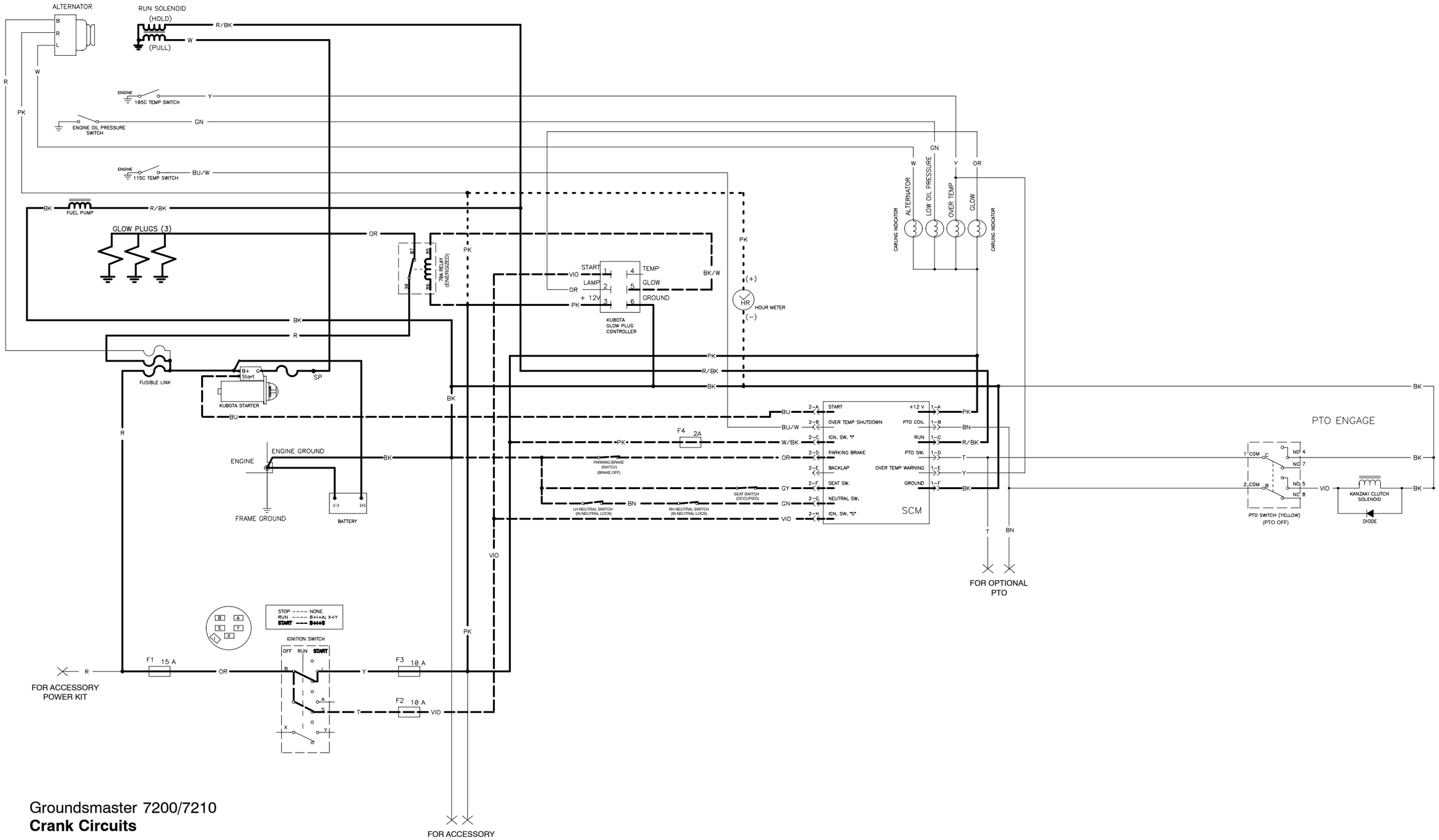
All relays and solenoids are shown as de–energized.

All ground wires are black.



Groundsmaster 7200/7210
Glow Circuits

Power Current
Control Current
Indication Current



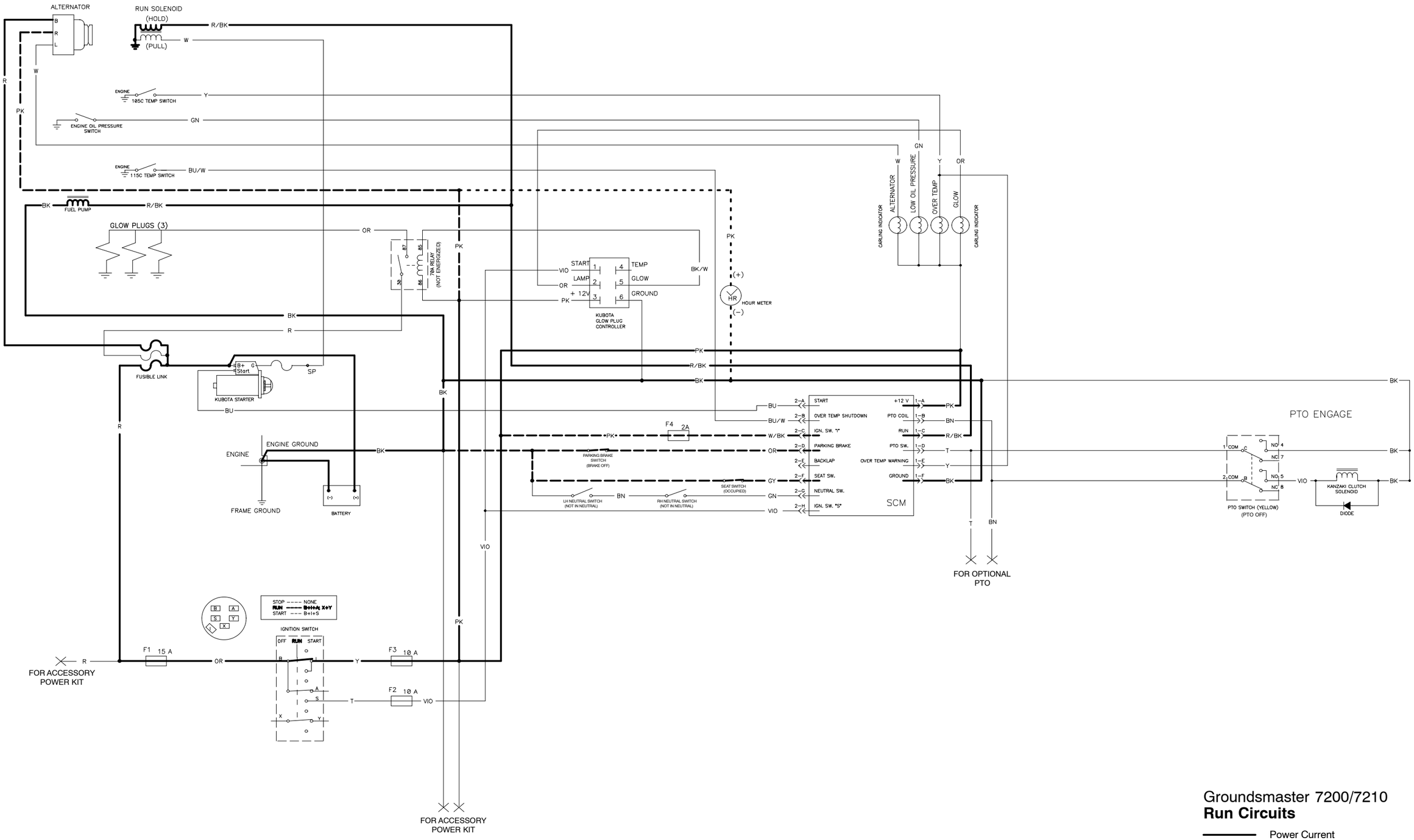
Groundsmaster 7200/7210

Crank Circuits

Power Current

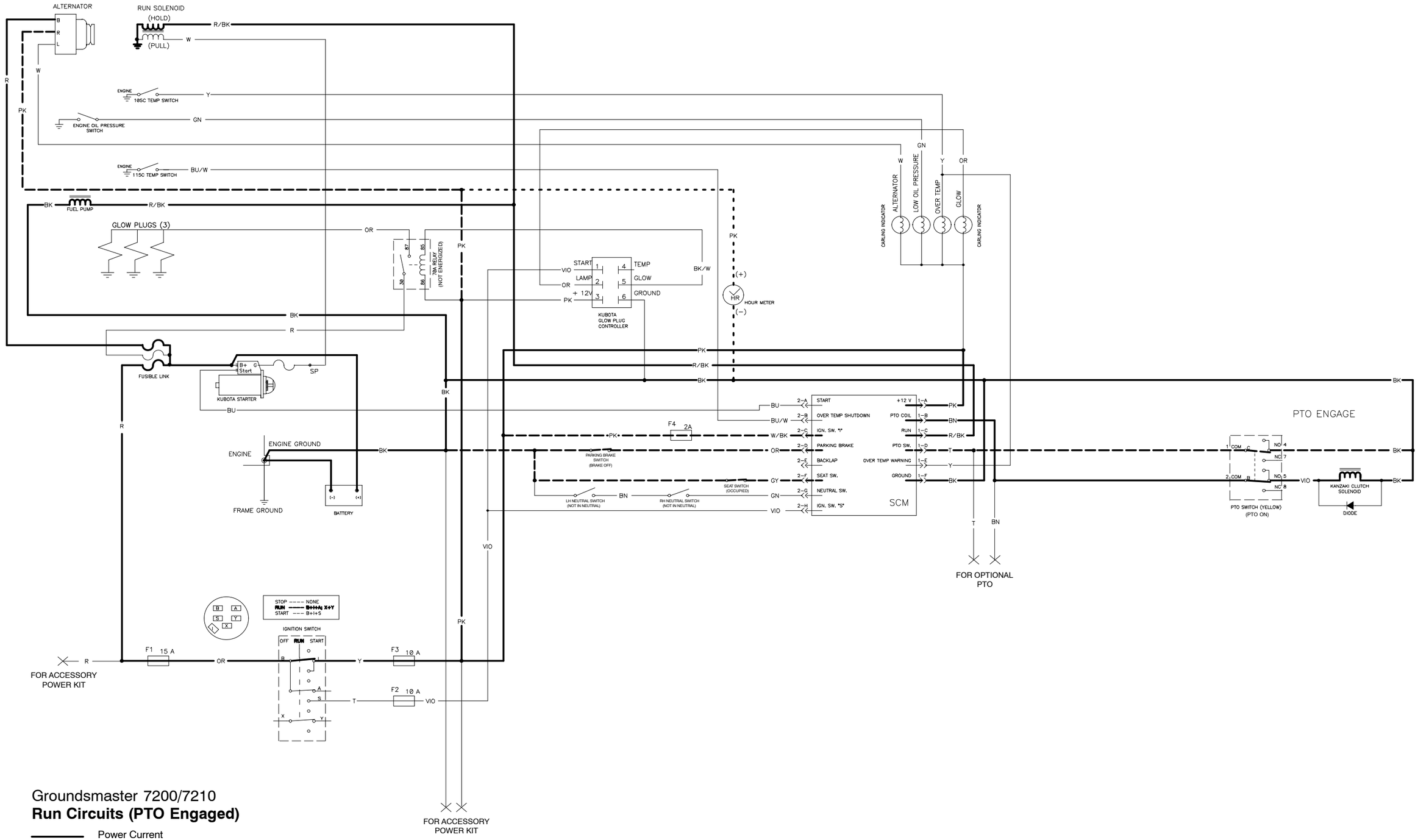
Control Current

Indication Current



Groundsmaster 7200/7210
Run Circuits

Power Current
Control Current
Indication Current



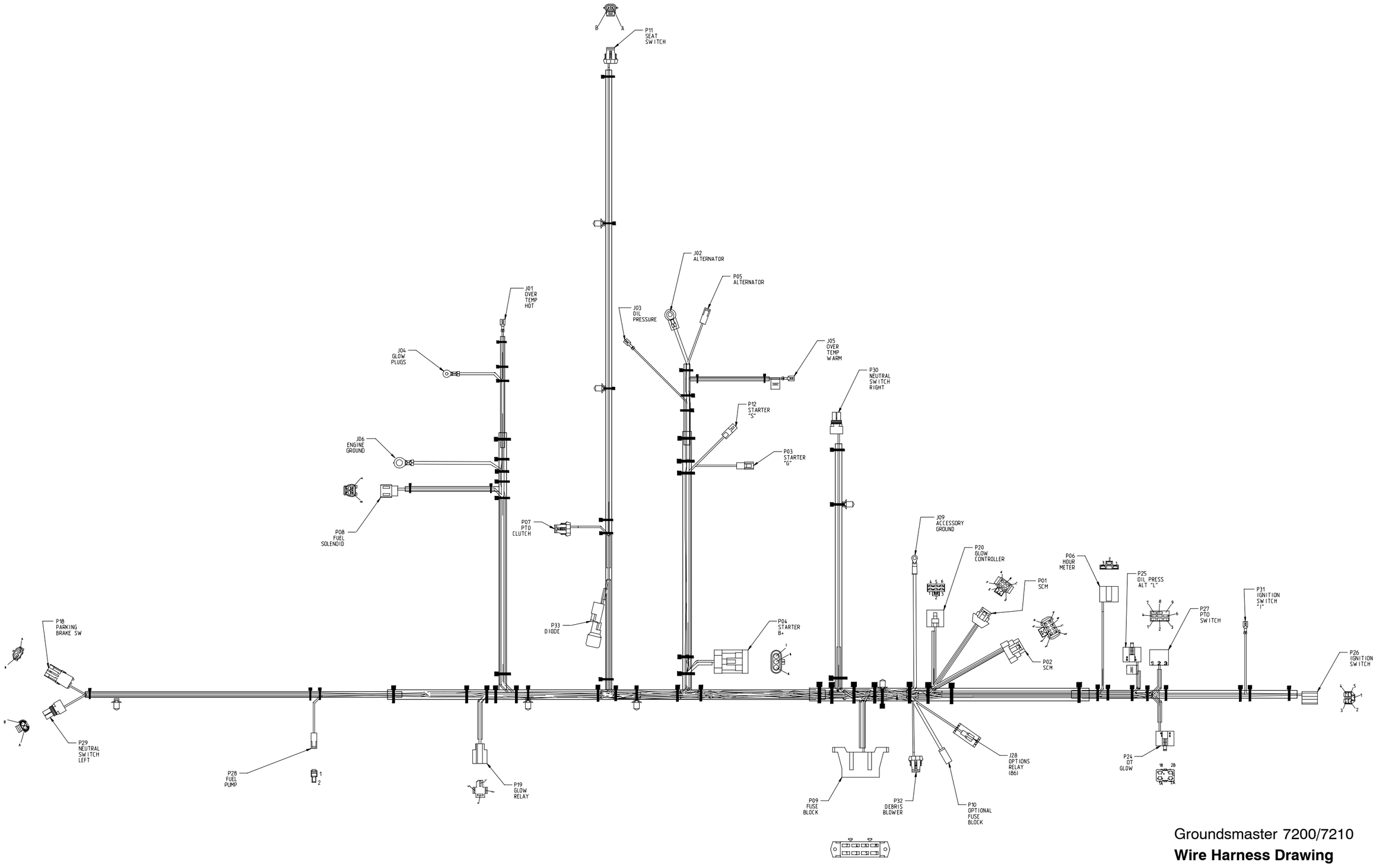
Groundsmaster 7200/7210

Run Circuits (PTO Engaged)

Power Current

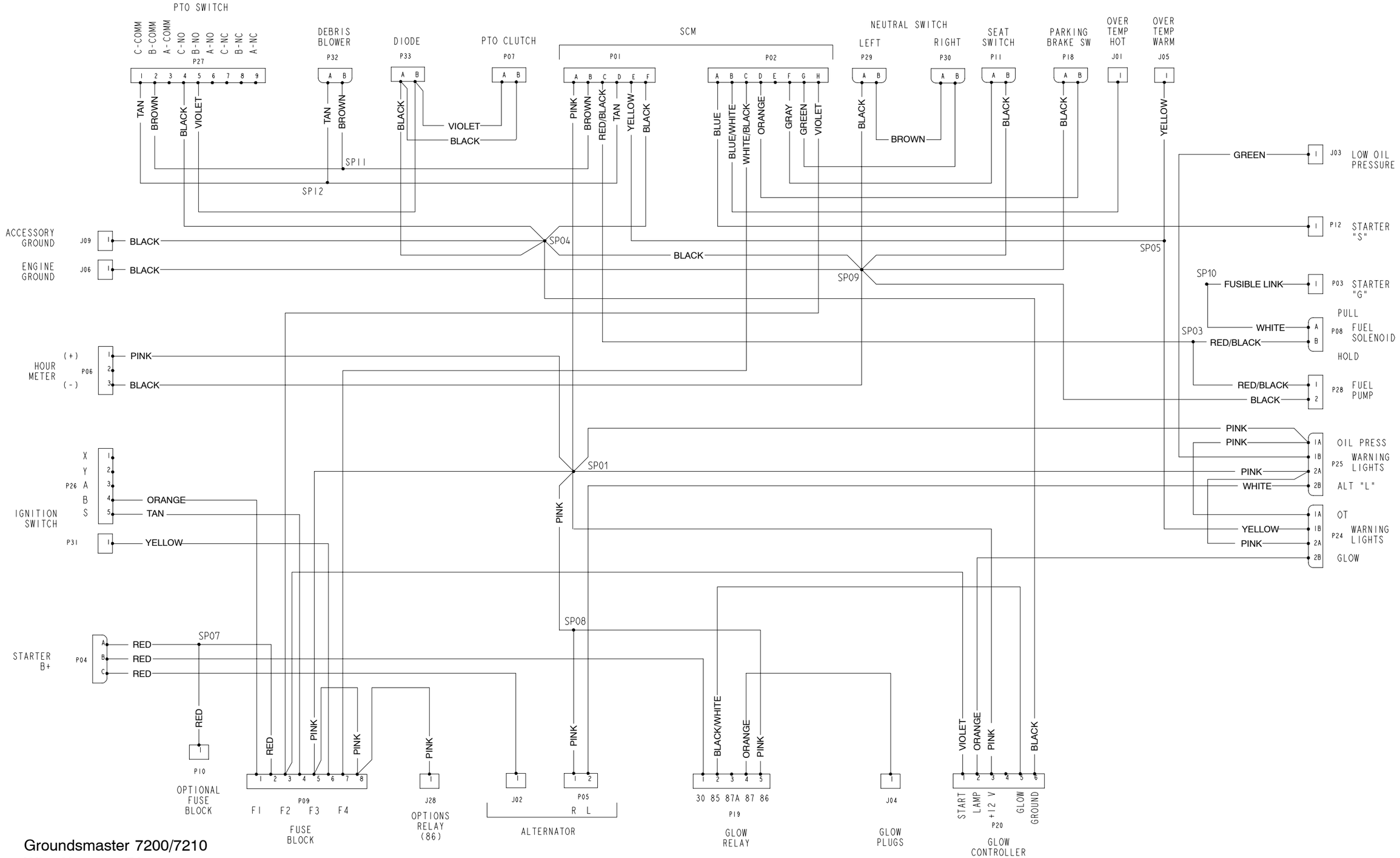
Control Current

Indication Current



Groundsmaster 7200/7210

Wire Harness Drawing



Groundsmaster 7200/7210
Wire Harness Diagram